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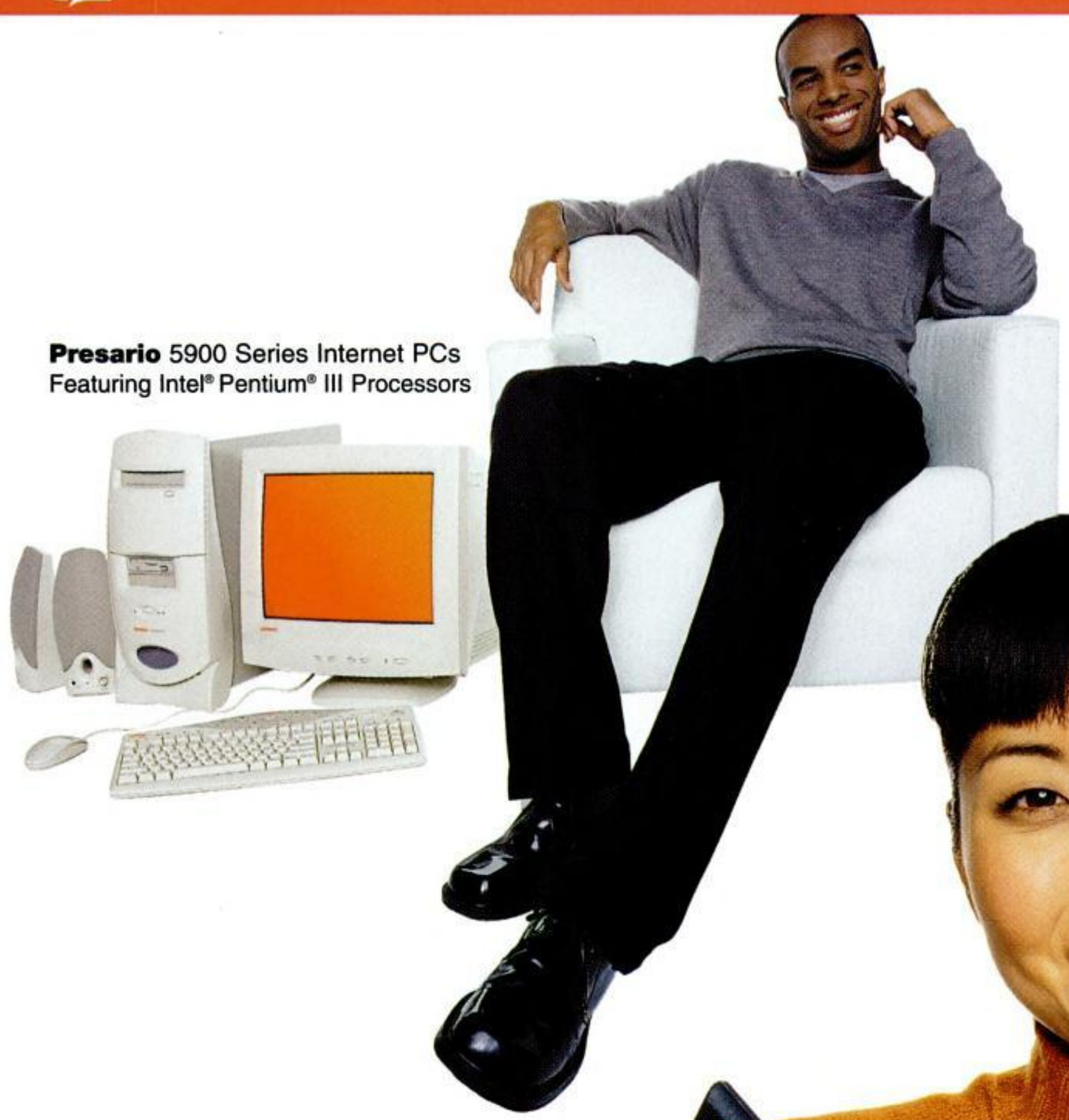

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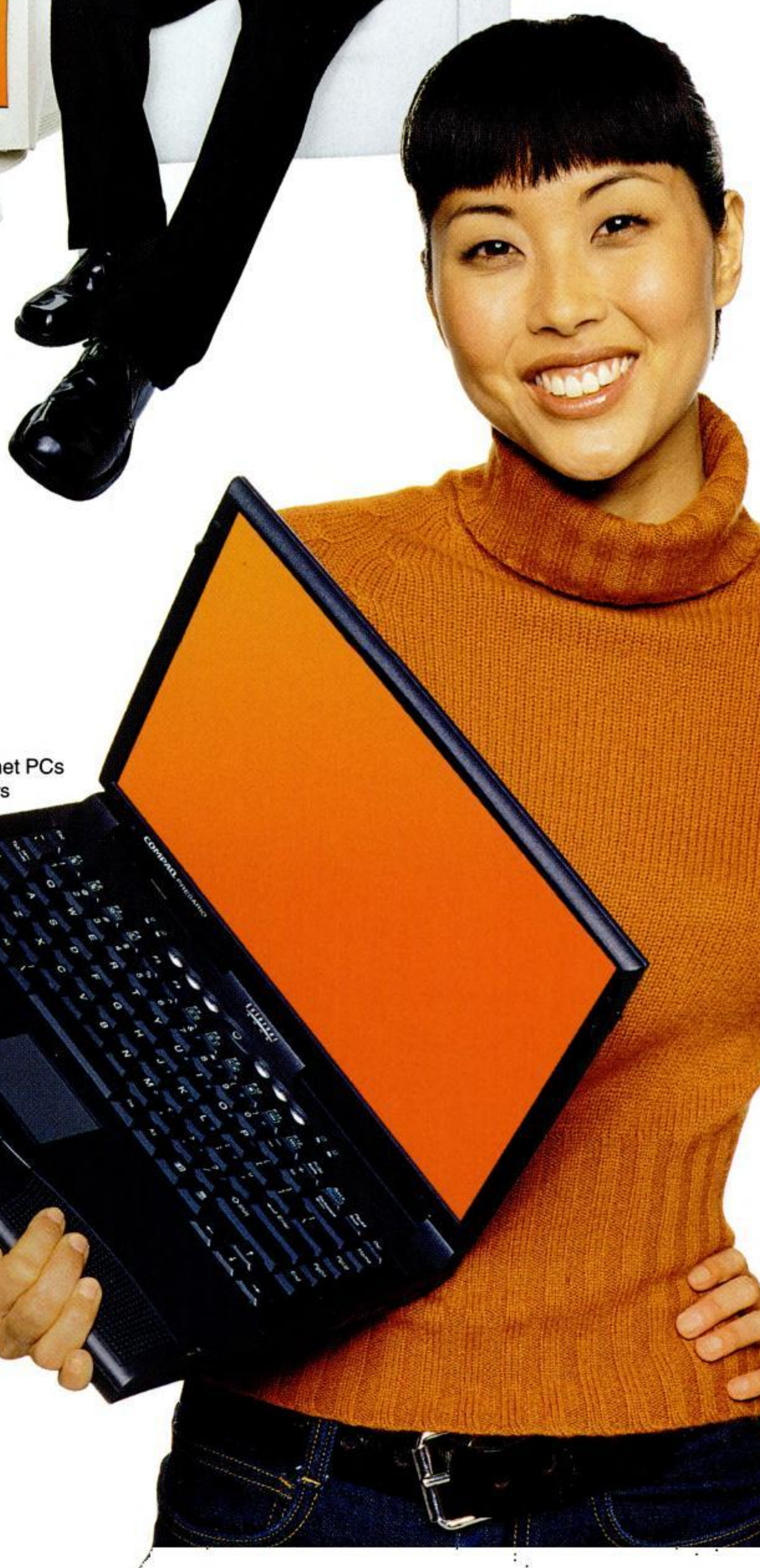

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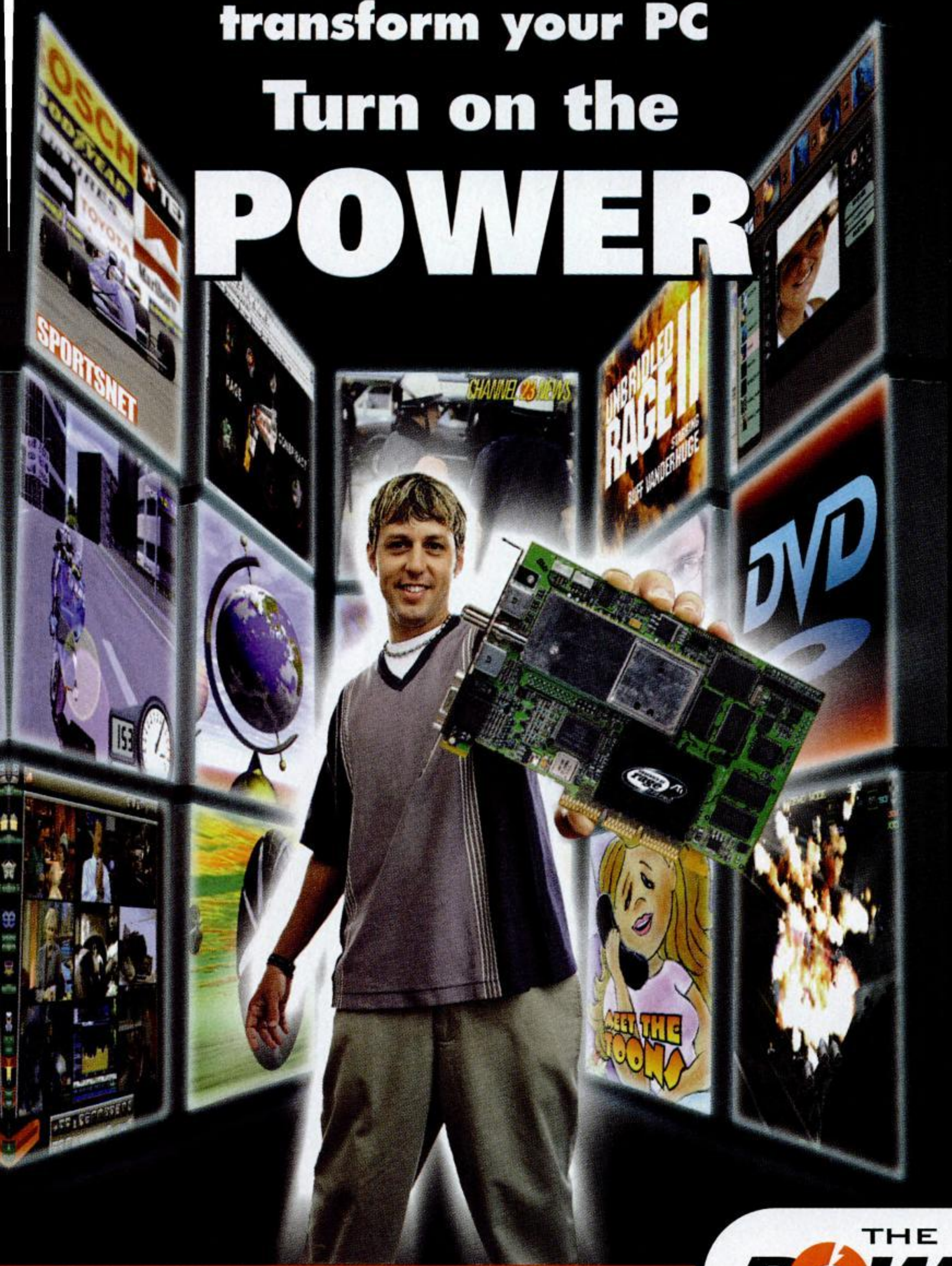

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APRIL 2000

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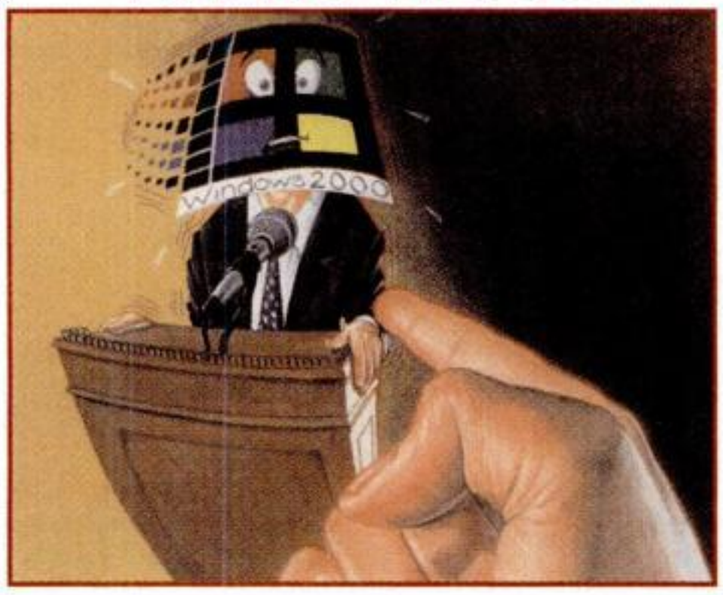

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Deus K7: **Polywell** marries an Athlon with IDE raid, and **Axis Systems'** Athlon has all the right parts but none of the right stuff... Into sound? **Creative Labs**, **Aureal**, and **Diamond** battle for top soundcard honors... Got space? **Maxtor**, **Quantum,** and **Seagate**'s ATA/66 hard drives want you—but which one do you want?... *Interstate 82* brings back "Miami Vice," and eight is a lucky number for *Final Fantasy 8*... Surprise upset: **TDK** snatches victory from both **HP** and **Plextor** in our 8x EIDE CD-RW roundup... Spring is the time for system upgrading, but if you haven't upgraded your videocard, don't do it until you see our comparison of the new **Hercules**, **Elsa**, and **Leadtek** DDR GeForce cards.

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PC Previews, News, and Factoids

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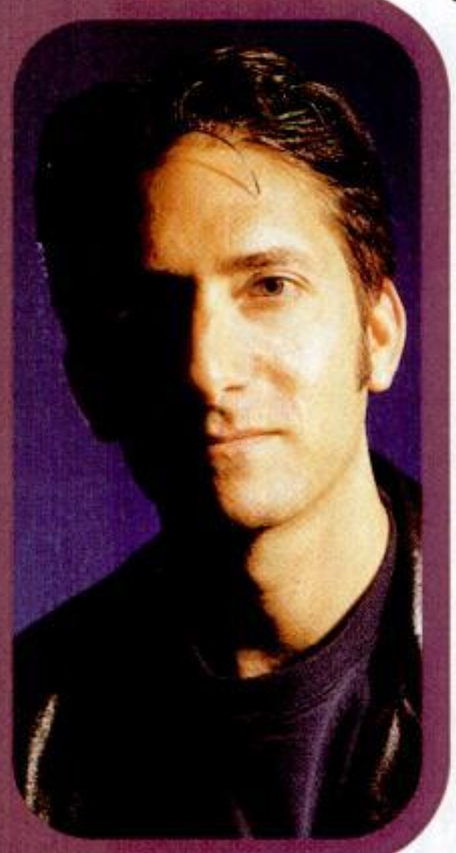
EDWORD

Ch-Ch-Ch-Changes

Maximum PC is anything but a static magazine. We constantly retool our content to better serve you, and this month we have an unusual number of changes. Submitted for your approval:



Terminator—It's gone. Audi 5000. Kiss it good-bye—from the back of the magazine, that is. Arcane tech terms will still be "hyperlinked," but instead of asking you to jump to page 102 for definitions, we'll send you to our online Terminator database at **www.maximumpc.com**. Why the change? We simply wanted to use the page for more dynamic editorial content, and leverage the unlimited amount of space that our web site provides.

The Table of Contents—It's now a single page. Once again, we wanted to use the space for more compelling content. Besides, do you really need that much hand-holding to navigate a magazine with color-coded page headers?

Net Sensei—Sherry Monarko will no longer be writing her column on web site creation and surfing tricks. As the Lead Designer for the ever-expanding Maximumpc.com, Sherry decided she didn't have enough free time to write a monthly column. She also wants to spend more hours tilling soil and being one with the world of flesh-and-blood, so she decided to resign her role at *Maximum PC*. We will not be replacing Sherry with another columnist—because how can anyone replace Sherry? We also feel the Internet has become an intrinsic part of the basic PC experience, so there's no reason to isolate Internet-related content in a single column.

The Month in Reviews—We now open the reviews section with a behind-the-scenes look at testing procedures and Lab shenanigans. If you really want a window into the *Maximum PC* lifestyle, go here first.

"Essay style" reviews—Multi-product review round-ups will no longer be broken up into separate critiques for each product. Instead, we'll use a "compare and contrast" essay format to give you a better idea of how the products stack up against one another in key areas.

Readershop.com—*Maximum PC* is partnering with this new web service to deliver online product information in a much faster, more direct manner. At the end of every product review, you'll find a URL for a specific Readershop.com page (for example, "www.readershop.com/mpc0421") and a phone number. Go to that page, and you'll find product information, along with a list of verified online retailers that are selling the product. Our goal is to save you time that would otherwise be spent sifting through multiple vendor and e-tailer web sites searching for a specific product.

We now open the reviews section with a behind-the-scenes look at testing procedures and Lab shenanigans. If you really want a window into the Maximum PC lifestyle, go here first.

Good-bye, Kevin Ashburn—*Maximum PC*'s art director is leaving the magazine to take a world tour of planet Earth. Kevin has been an essential contributor to not only the magazine's ironic visual voice, but also its overall tone. Kevin will be sorely missed, but we're replacing him with his excellent second-in-command—Ruth Walker is the new *Maximum PC* art director! Look for her to make a big impact in the May issue.

Let us know what you think of these changes. We're committed to refining the magazine with constructive feedback!

Jon Phillips
editor-in-chief

MAXIMUM PC

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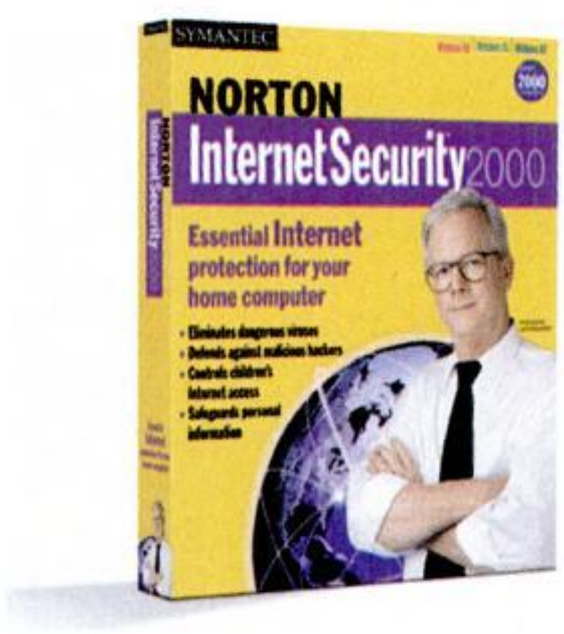

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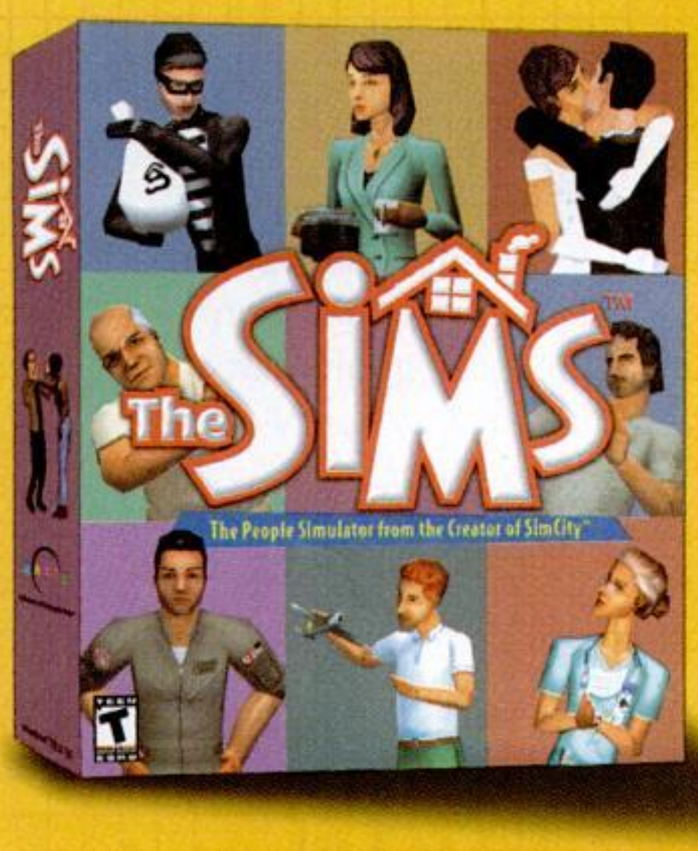

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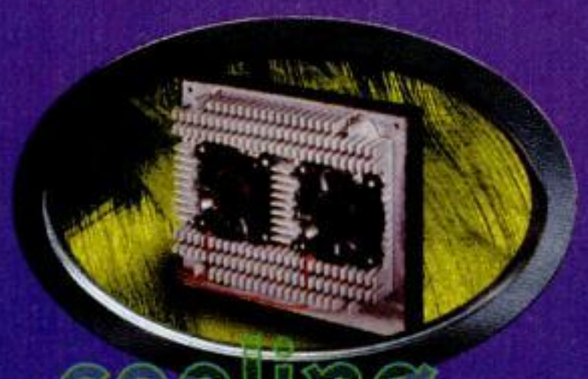

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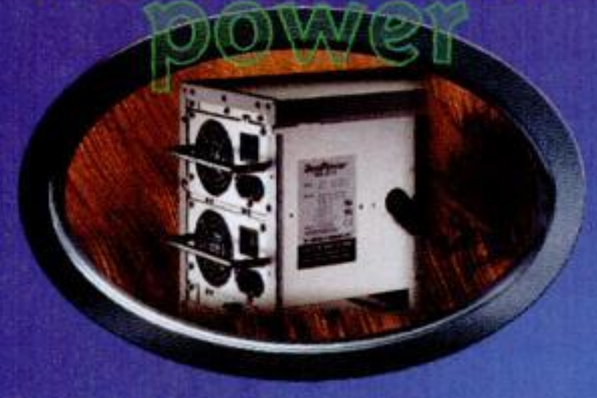

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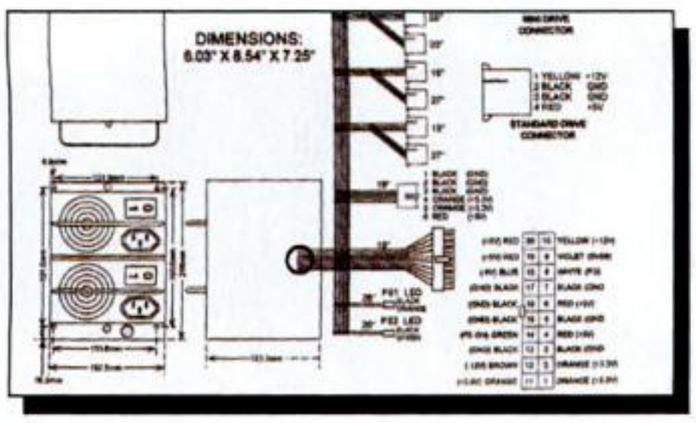

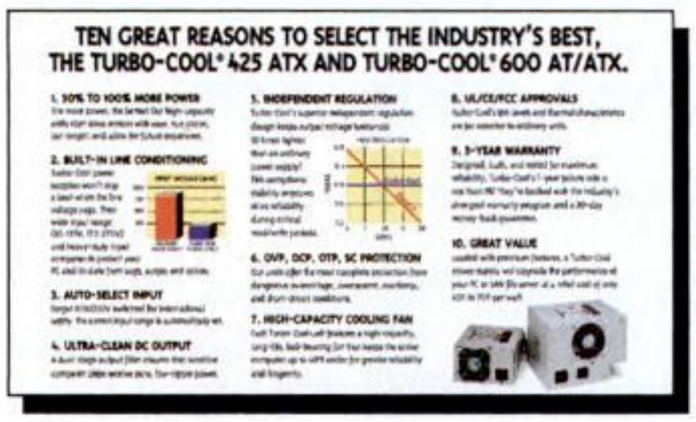
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Love Us, Love Us Not

Maximum PC has gone soft—that was the message that some of our readers sent us in response to the February issue. They didn't like our "low-tech rehash" of the MP3 phenomenon, nor did they care for our "stuffed shirt" look at online investing.

Has the magazine gone soft? We don't think so. But the February issue did cover two pastimes that are changing the way we use the Internet. *Maximum PC* is an ever-changing beast that does its best to serve the upper echelon of PC power-users, and within this group, readers have diverse wants and interests. Some months, we run a bit more softcore than other months, but we do our best to hit the sweet spot that serves both seasoned hardware junkies and people who are just beginning their PC addictions.

Our only personal gripe with the February issue is that we ran three Internet software-related features to the exclusion of any hardware features. This was the unfortunate result of a scheduling dilemma. We apologize for the imbalance—rest assured, we would have preferred a better mix. Nonetheless, we must note that our take on the MP3 phenomenon actually told readers how to search for illegal MP3s (a how-to story that other magazines have been too scared to address), and the February issue did indeed include hardcore content: a 3Dfx preview, Lab Notes testing on 2D videocard power, and reviews of Athlon mobos, to name just a few key pieces.

We feel the issue you're holding in your hands is hardcore to a fault—so let us know if you think we've now strayed too far into geekdom.

Keepin' It Real

So, which numb-nuts wrote the February issue review for *RealJukebox Plus*? Either you were so pissed off by the secret upload of your listening habits, or you just needed to take a piss so bad, you forget to do your job and actually use the entire program to see how it works. If you can give *MusicMatch* an 8 verdict, then *RealJukebox* should be a 6 or 7, with a lower mark because of its security issues.

Did you actually try loading more than one song into its Master Library? If so, you would have found it to work wonderfully. Organizing music by artist, genre, and album, and having a total list of all the music works great. The ability to rip files works very well, too. However, I do agree with you that it should offer better CDDB server support.

So let's see: It rips files quickly and accurately, does a good job of keeping track of music, plays files in any manner you like, and sounds good. It had a security issue that was fixed, and it can still do better on CDDB. Lets give it a 2 verdict? I don't think so.

—James McDaniel

Editor-in-chief Jon Phillips replies: The software's biggest problem was that it crashed every machine we ran it on—repeatedly (and, yes, we did verify that *RealJukebox Plus* was the culprit). That alone is inexcusable and worthy of a damning review. But let's use Mr. McDaniel's letter to make a larger point about our verdict scale: It spans from 1 to 10, and we like to use the full range of numbers when passing judgment on products. Only wimp magazines—like our competitors—shy away from the bottom end of their review scales for fear of offending vendors.

If a product is a strong also-ran in a field of more worthy contenders, it will probably score a 7 or 8. If a product is structurally sound, but clearly not worth anyone's time or money, it will probably score a 5 or 6. But if a product is decisively out-classed by competitors *and* introduces system instability, or just plain doesn't work, it receives the full brunt of our fury. *RealJukebox Plus* was more than just irrelevant in a field of better products. Our "out-of-the-box" experience with it thoroughly sucked, and it didn't work, period. It deserved a 2.

If you can give *MusicMatch* an 8 verdict, then *RealJukebox* should be a 6 or 7, with a lower mark because of its security issues.

Ripping Up on Analog Ripping

I have a comment about a remark made in February's "Complete Guide to MP3s." In the advanced recording tips, it states: "For minimum ripping times, rip digitally. For maximum quality, rip analog."

I disagree with this. Do you realize how much garbage that analog audio cable picks up from other electronic devices in the computer? Try turning on your CD-ROM input, turning its volume all the way up, muting other input volume controls, then turning up the master volume control. You'll hear lots of static, my man. Digitally ripping CDs eliminates the problem with static.

Also, the article states that digital ripping grabs the audio as fast as the CD-ROM can pipe it to the motherboard. Every digital ripper I have come across allows you to adjust the speed it rips it at. I digitally rip the audio at 2x speed and this gives me no problems and no (recognizable) errors. Some rippers include sync data transfer and pre-buffering to prevent errors from occurring.

—Matt Bronson

TOM

PC

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Contributing editor David Battino replies: Sorry for the confusion. You're correct: An exact digital copy will have better sound quality than an analog transfer made through cruddy circuitry. The author's point was that error correction decreases ripping speed, so you may be tempted to turn it off. But doing that will let any digital glitches pass through to the audio file. Additionally, higher ripping speeds generally increase the likelihood of errors. See **http://help.mp3.com/help/faqs/make-cdtips.html** for a list of additional system tweaks you can make to reduce digital errors.

Don't Stop the Vinyl Pop!

I wanted to comment on the mention of Adaptec's *Spin Doctor* in the February MP3 article. Most audiophiles will agree that *any* modification of the source signal—be it pop and click removal or normalizing—violates the source material. I have ripped many vinyl albums over the years, trying nearly every program available to "enhance audio with pop, click and scratch removal" and reluctantly settled on *no* program to do this, simply because, to my ears, no program can do it effectively.

How did I remove pops and clicks from my albums? I either didn't do it at all, or I simply used the mouse to draw out the click waveforms. This method is invasive as well, but it's considerably better than what any filter I've used can do (though it is time-consuming).

—Fishylip

Dell Is Swell, But Your Score Doesn't Gel

Let me be the first to say that the Dell system that recently received a perfect 10 verdict [March 2000] is indeed an impressive machine. However, my own wonderful journey into overclocking and enthusiast tweaking came as the result of a Dell machine, and I have to state the following:

▶ When upgrading my Dimension XPS 266, I ran smack into Dell's "dumbed down" BIOS. I wanted to set the AGP width (at the request of a last-minute technical insert in my videocard's retail box) and couldn't. Dell dumbed down the BIOS because it cuts down on help desk calls when less savvy customers set something wrong.

▶ The Dell motherboard was not truly ATX. The funky connectors for the hard-drive light, speaker, on/off switch, and reboot switch probably saved Dell a few cents per unit, but made me have to buy a new, truly ATX case for my brand new Abit motherboard. It was either that or get out the soldering iron and go to work on a ribbon cable with mighty fine 24-gauge wire—not something I felt like doing.

▶ My Dell power supply was only 200W—insufficient for any aggressive upgrade paths. And if memory serves, the Dell's power supply didn't have a proper ATX connector for the mobo.

▶ Even the Dell case fan I salvaged from the shell of the Dell box proved to be incompatible with the ATX case I recently purchased whilst building a system for my sister.

I find it hard to believe that Dell doesn't make these same design decisions today. If indeed they do not, then kudos to Dell and *Maximum PC* for a fine review. But if Dell still cuts corners in the name of "economies of scale," then the BIOS problem alone should've resulted in a Kick Ass/9 verdict, not a perfect 10.

I find it hard to believe that Dell doesn't make these same design decisions today.

Let's put it this way: When Dell was my rig, *PC Computing* was my rag. Today, my rig is hand-built and *Maximum PC* is my rag. And I have never looked back.

—Peter K. Rauch

News editor Gordon Mah Ung replies: The feature-poor BIOS (which we've kicked Dell for in the past) can't be helped if you stick with Intel-based OEM products. The BIOS that complements Dell's version of Intel's "Vancouver" VC820 board doesn't give you access to SDRAM latency or bus speeds—but that's the trade-off for using a mobo that offers rock-solid performance and stability. We must note that the Dell board does let you change the AGP aperture size.

While 300W is the minimum wattage for hobbyists without engineering teams behind them, we have to say we're amazed that Dell can get a box with RDRAM, a DDR GeForce, an 8x CD burner, an 8x DVD-ROM, Zip, 7200rpm hard drive, NIC, Sound Blaster Live!, and a v.90/G.Lite modem to work with 200 watts. Dell is able to do this by using that aux power connector and plumbing more 3.3V lines onto its motherboard. We also trust that Dell's engineers designed the B800R's power envelope so that the system doesn't die after two months of use.

But hey, we hear you, Peter. Sure, we would have loved a redundant power supply riding in a super-tower case, but life is about trade offs and we think Dell's build-out on the B800R was just awesome. We also must note that Dell can do something that no single end-user (or community of power users) can do: requisition an exclusive 64MB DDR GeForce card. We also have to give the B800R praise for its Hitachi DVD-ROM drive. In an MP3 ripping test, the Hitachi blew away almost every DVD-ROM we had in the Lab, including a 10x DVD-ROM drive and a TDK drive that's pimped out just for MP3 ripping. We didn't find a faster drive in our tests until we moved up to a 72x Kenwood CD-ROM drive.

No OEM on earth will ever put the love, care, and selection that hard-core hobbyists put into their own boxes. But if you're looking to buy a piece of perfection without dirtying your hands, the B800R is the machine to beat right now.

Clocking Mystery Cache

In your February issue, your review of the Falcon Northwest Mach V unit left me disturbed about something: the fact that someone can purchase an AMD Athlon CPU and not know that the off-die L2 cache operates slower than the speed of the CPU itself. My question is, How is the consumer supposed to know this, and what on the CPU tells us this? Is there a part number that we should watch out for?

—Gilbert Lozano

Reviews editor Josh Norem replies: To determine the cache speed

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FREEDOM 3

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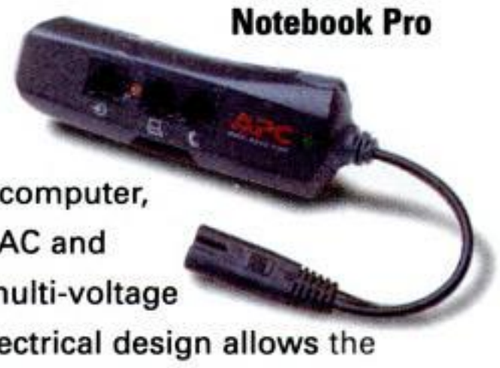

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of a particular CPU, you have to do your homework. You have a very small chance of getting the information directly from a vendor simply because the vendor assumes that most of the populace doesn't want to be confused by such terms as "closely-coupled L2 cache running at two-fifths core speed."

Our mole at AMD told us that AMD has never officially stated the speed of its L2 chips, either online or in print. Regardless, the cache speeds are well-known thanks to thorough review sites and magazines. In a nutshell, the information is out there; you just have to look for it.

Our mole at AMD told us that AMD has never officially stated the speed of its L2 chips, either online or in print.

All Athlons that run at 700MHz and slower have L2 cache that runs at half the core speed (e.g., 350MHz on a 700MHz CPU). Athlons that run at 750MHz, 800MHz, and 850MHz have L2 cache that runs at two-fifths the core speed. The reason is that the CPUs' off-die L2 SRAM chips can't comfortably run faster than 350MHz, so AMD must clock them down for reliability. If you're bent on having on-die, full-speed L2 cache—and who isn't?—you'll have to wait for AMD's upcoming Thunderbird core, which is expected to be released at 950MHz. Because the T-Bird's cache is intrinsic to the CPU itself, it has no trouble running at full speed.

Mobile 3D Warfare

The February issue contained a review of a Dell Inspiron notebook. The author wrote that the Inspiron would be much better if it had S3's Savage 4 mobile graphics chip. This chip appears to be far superior to ATI's 3D chip, which is currently dominating the notebook market.

Do you know of any notebooks that come standard with S3's chip, or any companies that plan to implement the chip soon? If not, why have manufacturers such as Dell and Compaq not gone to the Savage 4?

—Tim Mrock

Associate editor Geoff Visgilio replies: The Savage 4 is a desktop graphics chip. S3 scaled it down for notebooks in the form of the Savage MX and Savage IX, but these chips are of essentially the same design as their bigger S4 sister. Right now, S3's Savage mobile graphics chips are only available in high-end notebooks, but S3 tells us that will be changing. S3 compares ATI's current hold on the mobile market to NeoMagic's domination a few years back.

Revolutions in notebooks occur at a slower rate than changes to the desktop. Implementation occurs in phases, and S3 expects to be embraced by more vendors as old technology is phased out. But for now, the Rage Mobility P seems to be the standard among the big guys like Dell and Fujitsu, and it doesn't look like ATI is going to be ousted anytime soon—at least not until S3 can find a way to compete with ATI's superior DVD playback and offer an Out-to-TV option.

Toshiba's Tecra 8100 (which we'll review in our May issue) and some of Toshiba's high-end Satellite systems offer Savage graphics. Just be sure you look at the 8100 series and not the 8000 series notebooks, which are still using NeoMagic chips with only 2.5MB of video memory. NEC is implementing Savage technology in its high-end Versa series, and Micron announced it will be using accelerated S3 chips in its high-end notebooks, as well. Depending on how consumers respond, we may be seeing a lot more of S3 in the future. ✹

CUT, COPY, PASTE

In the February issue's Ask the Doctor column, we erroneously stated that Pioneer manufactures a DVD-RAM drive, when in fact it does not. Actually, Panasonic, Hitachi, and Toshiba make DVD-RAM drives. Pioneer does, however, make DVD-R drives.

In the March issue, the benchmark score listed in the Rage Fury Maxx review for *Quake II* is actually for *Quake III Arena.*

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– **Fred Lugano**, weatherization.com, Vermont

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technology preview ► CPUs

TransMeta's Crusoe

Mysterious upstart CPU emerges

It certainly wasn't the kind of CPU launch that the technology press is used to. After five years of cloaked secrecy, TransMeta CEO David Ditzel finally discussed the company's mysterious new CPU, dubbed Crusoe.

Ditzel, a bearded and bespectacled former Sun Microsystems scientist, discussed Crusoe's voltage envelope, its heat dissipation, and its battery life—not the kind of rhetoric that normally accompanies the machismo launches of CPUs. But then again, Crusoe isn't a "normal" microprocessor. What Ditzel and Co. announced last January is a blend of hardware and software technologies aimed at directly challenging Intel's dominance not on the desktop, but in the x86 mobile computing arena.

While many of the individual technologies in Crusoe have already appeared in commercial products in some form or another, this is the first time they'll all be seen together in a product intended for the x86-compatible consumer market. The three most talked-about of these technologies—VLIW, Code Morphing, and Long Run—are all fascinating in their own right, but together, they make Crusoe a serious contender in the portable space. The chip is power-efficient and can run software intended for any platform.

Diamond Multimedia's upcoming Crusoe-based web pad will let you browse the Internet for hours without killing the battery.

VLIW

VLIW, or Very Long Instruction Word computing, has been around for quite some time. While VLIW concepts are at the core of upcoming high-end CPU offerings from Sun (MAJC) and Intel (IA-64), TransMeta is the only company with announced plans to bring this type of computing to the masses.

VLIW design differs from a traditional superscalar design in that with VLIW, all instruction reordering and scheduling is done in the software by the compiler, not in the hardware by the CPU. A VLIW compiler examines sequential machine code to see which instructions can be scheduled to execute in parallel. It then arranges those instructions into instruction packets, each of which contains a fixed number of instructions to be executed simultaneously.

Crusoe's execution engine contains enough hardware to execute four instructions in parallel. At peak, Crusoe can simultaneously execute one floating-point instruction, one integer instruction, one memory access instruction, and one branch instruction. Crusoe's VLIW compiler bundles those four instructions together in a packet called a "molecule," and sends them to the execution engine to be processed.

Crusoe's VLIW design offers one important advantage over a more traditional superscalar design: By taking the burden of instruction scheduling off the CPU and placing it onto the compiler, Crusoe eliminates the need for complex scheduling hardware—hardware that significantly raises a CPU's transistor count. Crusoe's VLIW design, along with a number of other innovations, allows it do the same amount of work as many other x86 chips, but at a fraction of the transistor count. This lower transistor count in turn allows it to consume less power and dissipate less heat, both of which mean longer battery life and a more compact

SPIN CYCLE

This month's top stories broken down ►

HEADLINE	NEWS	DETAILS	THEIR SPIN	OUR TAKE
Willamette Breaks Out At 1.5GHz	Intel wants to put the pedal to the metal between "Pentium IV" or "iPentium" and Athlon.	Intel officials goosed an air-cooled, room-temperature Willamette to 1.5GHz months before the CPU is to arrive.	With the first new 32-bit architecture since the Pentium Pro, Intel will introduce a new set of instructions, a quad-pumped 100MHz bus, a new chipset, and a new socket.	Intel is majorly pissed about Athlon and hopes to take AMD out with a single shot.
Bugs Plague Windows 2000	At launch, Windows 2000 contained no fewer than 65,000 known bugs, according to a Microsoft memo leaked to the tech newspaper *Smart Reseller*.	The memo shows that Microsoft execs think 28,000 of the bugs may be "real" problems, as opposed to the normal problems with a new OS.	Microsoft says the fact that they know the bugs exist is a testament to how thoroughly they've tested and dissected the new OS.	Wait for Service Pack 1 or for Microsoft to pare down the "real" bugs to 10,000 before wading in.

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

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design for mobile units that are based on the technology.

You can't get something for nothing, though, and Crusoe is no exception. Moving the CPU's instruction scheduling functions into software slows down performance, which means that Crusoe will perform significantly slower than an Intel or AMD x86 offering at the same clock speed.

Code Morphing

Crusoe's VLIW compiler is a little different from a normal VLIW compiler. It's actually better termed a "translator," or a "Just In Time" compiler (JIT), because it takes sequential, precompiled x86 code (the OS, applications, drivers, etc.) and translates it, on-the-fly, into the "molecules" that constitute Crusoe's native VLIW instruction format. Crusoe's JIT compiler is one part of a complex piece of x86 emulation software called the Code Morphing layer. This Code Morphing layer is stored in a special boot ROM; it's the first thing that's loaded when Crusoe powers up. It's also the only piece of software that's actually written in Crusoe's native VLIW instruction set, which means it runs as fast as possible on TransMeta's hardware.

The x86 "translations" produced by the Code Morphing layer are stored in a special "translation cache." This translation cache keeps the most frequently used pieces of code readily available in translated form, so they don't have to be translated again each time they're needed. The Code Morphing layer also polls constant usage to determine exactly which sections of the code in the translation cache get used the most often. It then spends extra cycles optimizing those sections for maximum efficiency.

Crusoe's Code Morphing layer offers Crusoe-based devices the advantage of running software compiled to any instruction set (x86, PowerPC, etc.) without requiring a hardware upgrade. TransMeta can modify the Code Morphing software to support a new instruction set, then issue a patch allowing Crusoe-based devices to run software based on that instruction set.

This advantage works the other way, too. TransMeta can make substantial design changes to Crusoe's VLIW hardware (to beef up the execution units, for instance) without worrying about breaking the existing application base. After recompiling the Code Morphing software to run on the new hardware, users who buy the upgrade can run all of their existing applications on it.

In spite of the Code Morphing layer's many benefits, it's invariably true that running software in emulation is slower than running it natively. Crusoe is no exception to this rule. Code Morphing software shares CPU cycles with OS and application code, slowing everything down in the process.

Crusoe At A Glance	TM5400	TM3120
CORE FREQ	333MHz to 400MHz	500MHz to 700MHz
L1/L2	96K/none	128KB/256K
PRICE (IN LOTS OF 1,000)	$65 to $89	$119 to $329
POWER CONSUMPTION	20 milliwatt to 1 watt	8 milliwatt to 1 watt

Long Run

One of the most underestimated but most important and innovative aspects of the Crusoe technology is the Long Run power management system. Long Run allows Crusoe to adjust its MHz rating and voltage level to meet the needs of its workload. Thus, if a user were doing something taxing like playing a game, the chip would probably be running at its highest MHz rating. If the user fired up something less CPU-intensive, Crusoe would scale back its clock speed until it had just enough horsepower to run the spreadsheet.

Whenever Crusoe reduces its clock speed, it also reduces its core voltage, a trick that offers significant power savings.

What This Means to You

If you're a power user or a gamer and you were holding your breath for TransMeta to announce the Next Big Thing in x86 performance, keep holding it. TransMeta's primary goal is to keep power requirements to a minimum, while maintaining an acceptable level of performance on everyday applications like web browsing and word processing.

Crusoe's ability to run on very little electricity should translate directly into longer battery life for notebook users. Since the battery accounts for a significant portion of a laptop's weight, laptops based on the technology should be lighter and more compact than their non-Crusoe cousins. Crusoe won't burn up your desktop with stellar frame rates or superfast *Photoshop* filter times, but it might lighten your laptop to the point where you no longer need to see a chiropractor after a day of business travel.

—Jon Stokes

to the pertinent details.

◀18

HEADLINE	NEWS	DETAILS	THEIR SPIN	OUR TAKE
Dell: Athlon 'Too Fragile'	Michael Dell farted in the general direction of AMD by saying that Athlons were more "fragile" than Pentium IIIs.	Dell made the comment to reporters in London while addressing compatibility issues with Athlon-based systems.	Dell says some of his customers on the "lunatic fringe" of PCs like to swap components, and that the surrounding Athlon infrastructure isn't strong enough to support this.	Mr. Dell has a point, but coming from a man whose company carries much water for Intel, you have to wonder if the remarks weren't self-serving.
Microsoft To Force Registration	Microsoft will force new users of Office 2000 to register the product after 50 uses, in hopes of stemming a growing problem with counterfeit software distributed on the Internet.	The forced registration won't go into effect until the company releases a patched version of Office 2000 later this year.	Microsoft said it's being forced to employ the registration tactic in response to "two million" web sites that sell or distribute pirated software.	Though there's two victims in counterfeiting—the software companies and the end user—Microsoft's heavy-handed approach is sure to piss off those concerned with privacy.

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ATI Reveals GeForce Killer

Canadian company lets slip some deets on its upcoming chip

Despite appearing in more PCs than any other chipset maker, ATI still doesn't get any respect. Sure, it's dominated the middle-of-the-road graphics scene for years, but the company has never topped the A list for power users. This year, however, ATI is determined to create a graphics processor that earns serious props—so serious, in fact, that the currently unreleased name for its newish chip will break from the company's long standing Rage line of products.

ATI gave *Maximum PC* an early preview of a chip that's so secret, the company would neither confirm nor deny the codename for it. With an entirely new architecture, the new 0.18-micron graphics processor should run at 250MHz and pump at least one gigapixel per chip. Combine this with ATI's dual-chip Maxx technology, and you'll have a videocard that could put even 3dfx's quad-chip Voodoo5 6000 to shame.

But ATI says its first order of business is to make sure it does the job right. With every graphics company adding hardware geometry features and developers increasing polygon counts in games, ATI said its onboard geometry engine won't take the performance hit that Sony's Playstation 2 and nVidia's GeForce do when geometry detail is dialed up. ATI wants to be sure that its new geometry engine will not only offer raw performance, but also enable games to use geometry acceleration without slowing down lighting or texturing.

Though the codename of the chip wasn't disclosed, ATI has dubbed the engine "Charisma." The Charisma geometry engine should be able to push more than 30 million triangles per second, roughly twice that of nVidia's GeForce.

But triangle rates aren't the Charisma engine's only attribute. It will also be able to enhance the realism of 3D models through vertex blending and vertex tweening.

Vertex blending allows developers to create realistic 3D models with a higher level of articulation at the joints, without the tearing we get today. In essence, vertex blending stretches the surface of a polygon across a vertex's rotation matrix in order to cover the crack that forms as the object moves. The GeForce supports vertex blending using two matrices, which is enough for one dimension, such as an elbow joint. The Charisma engine will support up to four matrices, which will allow articulation of a shoulder joint, or even a hand or a face, without tearing.

Vertex tweening—a feature common in advanced 3D modeling apps—will allow game developers to use ATI's Charisma geometry engine to morph polygon models through the use of vertex keyframes. Once handed a set of facial expression keyframes, for example, vertex tweening can interpolate all the individual frames as the expression passes from a smile to a frown. Vertex blending is currently supported through DirectX 7.0, and vertex tweening will come in DirectX 8.0. Both technologies will also be available as OpenGL extensions.

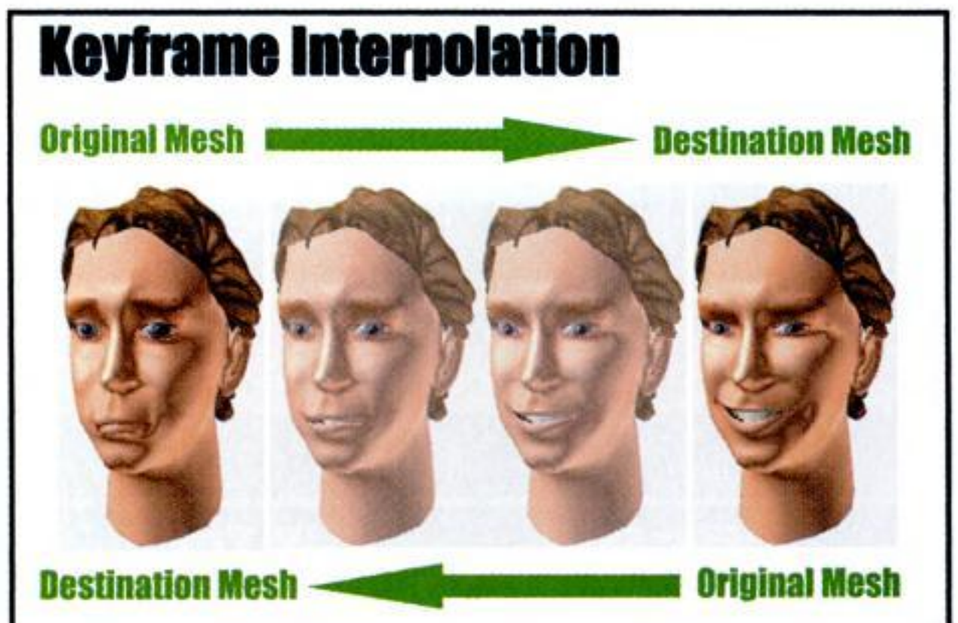
ATI's next-gen processor will also feature a new rendering architecture, dubbed Pixel Tapestry, that sports three texture units per pipeline, allowing complex texture mapping to be applied in a single pass of the rendering engine. With three texture units, multitexturing effects that would normally require several passes—such as detail textures, bump maps, shadow maps, and multiple lightmaps—can be used without bogging down a game's frame rates. ATI isn't ready to reveal how many rendering pipelines its next generation chip will have, but you can bet that it will have at least two.

Other new technologies that will find their way into ATI's next-gen videocards are dot product and environment-mapped bump-mapping, 3D textures, and projective texturing—all features that should increase the realism of graphics.

While these technologies make for a great chip on paper, keep in mind that a lot can change between now and the third quarter of this year, when ATI plans to release the cards. If ATI can pull it off, the company may finally garner the respect from power users that it's been seeking.

—Sean Downey

ATI's Charisma engine should comfortably pump out 10,000 fully textured polys per frame, allowing for more realistic models like the gorilla above.



ATI's new vertex tweening technology frees game developers from calculating every single intermediate frame between two different polygon meshes.

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

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▶ Maximum PC takes a bite out of bad service and gear

WATCHDOG

ILLUSTRATION BY SCOTT LAUMANN

NO DRIVERS, NO CRY

DEAR DOG: I used to swear by Diamond and recommend its products to everyone, but now it seems the company is telling me to go to hell by not offering tech and driver support for my Monster Sound MX300.

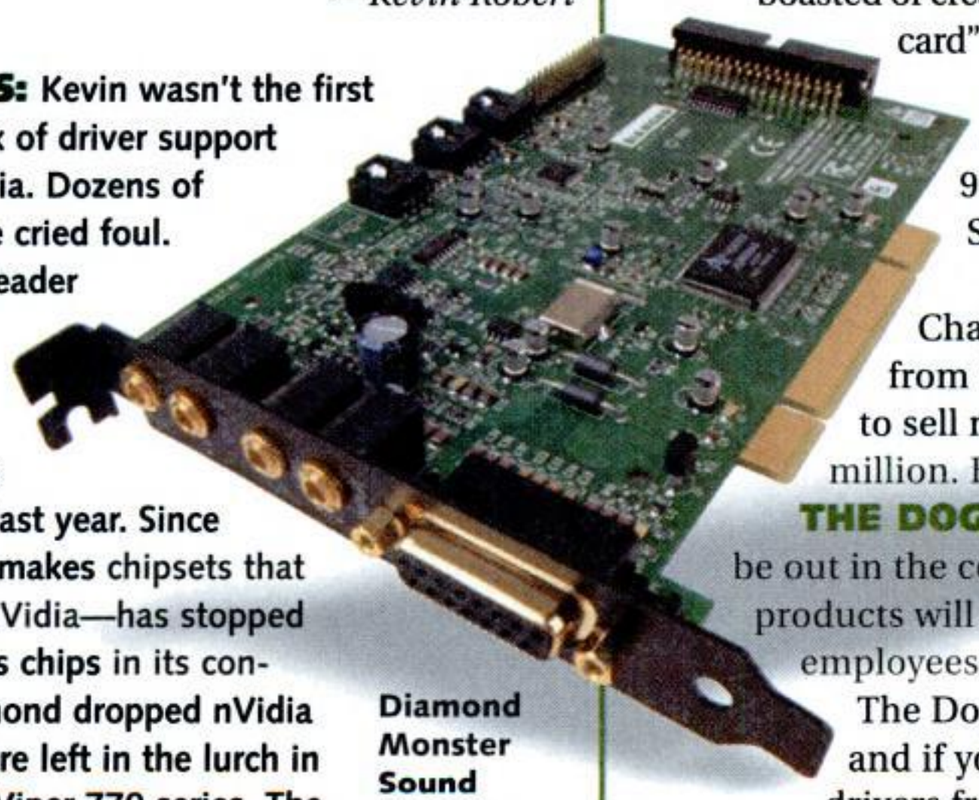
I wrote the company in February of 1999 to see when new MX300 drivers would be released and the response was, "We're working on it; go get the reference drivers if it's that big a deal." What the heck happened? Did Diamond stop caring? Could I get an answer please? I even wrote and told the company that I would buy Creative if it didn't shape up, and would recommend the same to my friends. The reply was not what I expected, either: "Do what you feel you must, we're working on it is all I can tell you, sir."

Could you get some kind of response for me, or should I save my hard-earned money and buy a Creative Labs Sound Blaster Live?

—Kevin Robert

THE DOG RESPONDS: Kevin wasn't the first person to bark about lack of driver support from Diamond Multimedia. Dozens of Diamond customers have cried foul.

Once respected as a leader in cutting-edge gaming technology, Diamond has lost some of its shine since chipmaker S3 purchased the company last year. Since the takeover, S3—which makes chipsets that compete with 3dfx and nVidia—has stopped using competing graphics chips in its consumer cards. When Diamond dropped nVidia from its lineup, many were left in the lurch in terms of support for the Viper 770 series. The company has since rectified the problem with its nVidia customers by supplying a new revision of drivers for the Viper 770 and 770 Ultra.



Diamond Monster Sound MX300

But the problem seems to runs deeper with Diamond's former partner, Aureal. Aureal provided the chips that powered the popular MX300 soundcard. Unhappy with the way the merger went and with Diamond's promotion of the card, Aureal split to sell soundcards under its own brand. Since then, Diamond officials tell **THE DOG**, it's been extremely difficult to obtain source code for the MX300.

"The company plans to provide support for existing products, including the MX300," Diamond spokeswoman Stacey Long told The Dog. "[The lack of drivers] is certainly a concern for us and we're definitely well aware of the issue." Long says proof of Diamond's commitment is the release of the latest Viper 770 drivers.

At press time, however, Diamond had yet to post any MX300 drivers, and the last update was a year-old beta version released just months after the MX300 first hit the streets. But, while Diamond's performance with drivers has been lacking of late, The Dog won't put the company in the Dog House just yet. The Dog does, however, recommend that you avoid buying an MX300 until Diamond can prove it plans to support the card.

S3 PLUS NINE

In late 1999, S3 scooped up the remains of famed 3D-card and chipset maker Number 9. Number 9 was known for its Beatle-themed graphics chips and cards, with such names as Imagine, Revolution, and Ticket To Ride. The company also boasted of creating the "first high resolution graphics card" for the IBM PC with an amazing 1024x1024 with 16 colors. Eventually, Number 9 shipped cards based on S3's Savage chipsets.

"What the heck happened? Did Diamond stop caring?"

The company filed for Chapter 11, or protection from creditors, late last year and agreed to sell most of its assets to S3 for $4.8 million. But S3 and Number 9 officials tell **THE DOG** that Number 9 customers won't be out in the cold. Driver support for Number 9 products will continue, and many of Number 9's employees will continue to work for S3. Let The Dog know if this statement is bunk, and if you're having problems obtaining drivers from Number 9 on current products.

ZEN TECH SUPPORT

DEAR DOG: This letter is to say, "Job extremely well done" to Kenwood. My 40x CD-ROM drive started doing the hide-and-seek thing—sometimes it was there, sometimes it was not—about four days before my one-year warranty expired. I contacted Kenwood support by phone and e-mail, and, surprisingly, the techs got back to me promptly. When they could not solve my problem, they directed me to get an RMA and to return my drive.

My 40x40 drive was delivered to Kenwood on February

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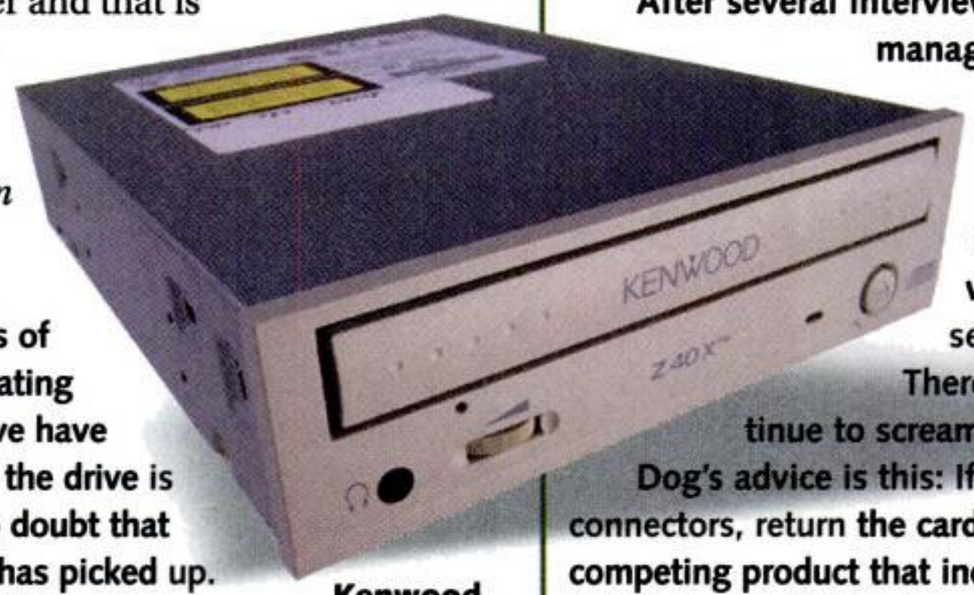
1, 2000, and my new 52x True-X CD-ROM drive was delivered to me on February 7th at 6 p.m. via UPS three-day delivery. The drive works well—I just installed it and ran some benchmarks on it. Wow.

Other companies should take note. The support staff was helpful and courteous, and service was prompt. Kenwood has done right by me and restored my faith. God forbid that this drive malfunctions, but their handling of my case makes me feel that any difficulty will be handled in the same manner and that is very reassuring. Now, back to adventuring in Faerun [*Baldur's Gate*]!

—Shangoman



Kenwood Drive

THE DOG RESPONDS:
Anyone who follows the rants of THE DOG knows what a beating Kenwood and its Zen 40x drive have taken. While the reliability of the drive is still being debated, there's no doubt that Kenwood's technical support has picked up. The Dog has received several letters giving Kenwood Tech a nod, and thinks it's time to give those hard-working techs a pat on the head.

"Could you please tell me, what is the truth?"

I WANT MY DVI

DEAR DOG: I read *Maximum PC* all the time and have recently built a computer based upon your ratings of components. The videocard I purchased is the Creative Labs Annihilator Pro that the mag raved about in the December 1999 issue. When I received the card, it was nothing like what ran in the article. The card I received only has the port for the monitor; it does not have the S-video port or a DVI port. With this card, I cannot watch my DVDs on TV. The picture on page 128 [of the December issue] shows these ports clearly. I contacted Creative Labs several times about this and both times I was told they never had an Annihilator Pro with these features. Could you please tell me, what is the truth?

—Duff Watson

THE DOG RESPONDS: **It's unusual for THE DOG to play investigator on its own magazine, but it appears the bulk of the problem resides in a miscommunication between *Maximum PC* and Creative Labs. When Creative Labs submitted the Annihilator Pro to the magazine for review, it labeled it as a reviewable product. To *Maximum PC*, a reviewable product is one that's structurally identical to a shipping product. Unfortunately, Creative Labs defined "reviewable" as a reviewable chipset that would give readers an idea of how fast the DDR GeForce would perform. The two definitions clashed when Creative Labs decided to remove the DVI and TV-Out connectors at the last minute before shipping the retail version of the card. *Maximum PC* apologizes for its end of the miscommunication.**

Creative officials say the features were removed because the quality of the TV and DVI output wasn't "up to their standards." They also told The Dog that they don't plan to offer the features in the Pro series in the future.

Should the Annihilator Pro retain its score or be bumped down? Some readers believe that the Pro should indeed lose its vaunted Kick Ass rating, while others believe the card is deserving of the score based on its stellar performance. After evaluating what happened and the performance of the card, the magazine stands by the review and does not believe the verdict needs to be downgraded; the board would still win a Kick Ass on performance alone.

After several interviews with *Maximum PC* staff and managers, as well as with Creative Labs, The Dog does not believe the company intended to commit a bait-and-switch on readers. It must be noted that a clarification was printed in the February letters section of the magazine.

There's no doubt that people will continue to scream bloody hell over the mix-up. The Dog's advice is this: If you were shocked not to find the connectors, return the card to your retailer and purchase a competing product that includes the features. If you're angry at *Maximum PC*, the Dog recommends a similar strategy—as always, let your dollars speak.

BLAME CANADA!

DEAR DOG: I saw your article in the February issue concerning Toshiba's payout to notebook owners. It appears to apply only to US residents, though. Do you know of any similar compensation deal being offered for us Canadians?

—Jon Green

THE DOG RESPONDS: **Unfortunately, Toshiba's settlement for $2.1 billion over an alleged defective floppy controller used in Toshiba notebooks and laptops appears to be American-only at this point. American attorneys who filed the original suit against Toshiba tell THE DOG that they're unaware of any similar suits filed outside the U.S. If you've got a good Canadian class-action attorney on tap and a Toshiba notebook manufactured between 1985 and 1999, maybe you can start the ball rolling.**

Attorneys who filed the suit in the U.S., meanwhile, have been busy expanding their case. Similar suits have been filed against Compaq, eMachines, Packard Bell, Hewlett Packard, and NEC, all claiming that those companies' PCs used the same allegedly defective floppy chip that Toshiba's did. The companies have largely dismissed the suits as an attempt to "exploit" Toshiba's large settlement and say there's no danger to customer data. One thing is for certain: Compaq attorneys don't want a P.R. fiasco. The company has filed a motion to muzzle those involved in the litigation from yakking with the public or press.

Is there really a danger to your floppy data? The Dog doesn't know, but Toshiba's decision to pay out $2.1 billion instead of fighting it out in court makes The Dog think that there very well could be a problem. If you've used your system for years without floppy problems, though, you shouldn't sweat bullets over this issue until the courts settle it. Watch this space for updates. Woof.

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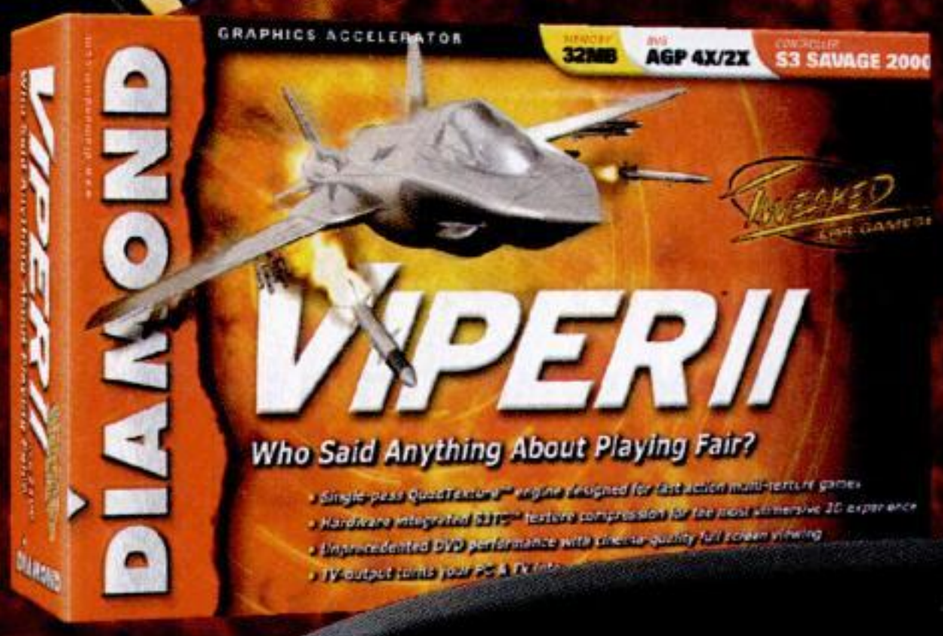

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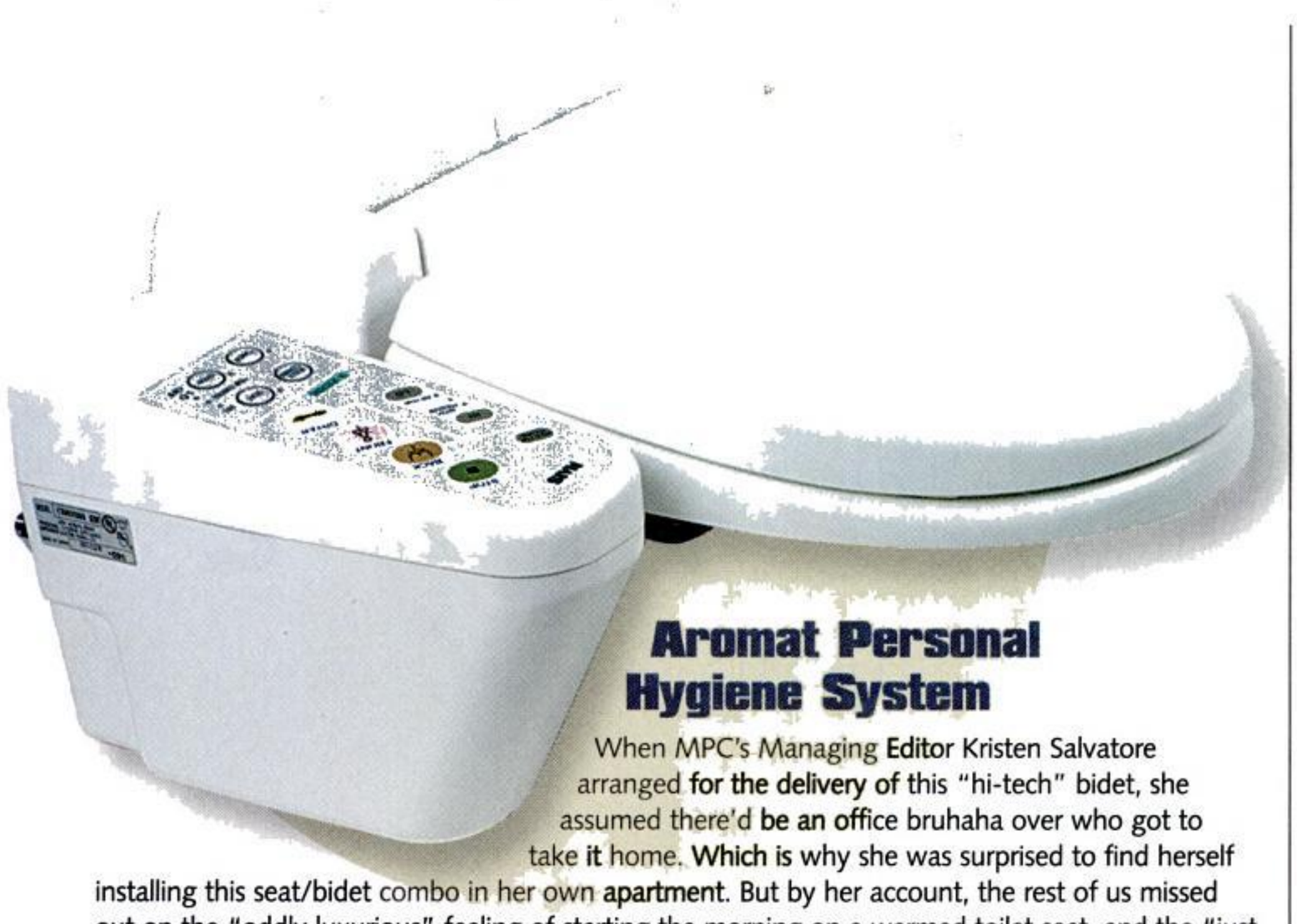

Aromat Personal Hygiene System

When MPC's Managing Editor Kristen Salvatore arranged for the delivery of this "hi-tech" bidet, she assumed there'd be an office bruhaha over who got to take it home. Which is why she was surprised to find herself installing this seat/bidet combo in her own apartment. But by her account, the rest of us missed out on the "oddly luxurious" feeling of starting the morning on a warmed toilet seat, and the "just plain odd" feeling of front and back cleansing (choose pulsing or spraying water) followed by a warm-air dryer. It was new to us, but bidets are a bathroom staple throughout the world. This one installs onto your existing commode and includes an automatic deodorizer and an anti-slam seat. Kristen's final word on the matter? "I feel like there's actually a reason now to call it 'the throne.'" (Note: Kristen happens to have some plumbing experience; Aromat recommends you have a professional install the PHS.) **$899; Aromat Corporation; www.aromat.com; 800.223.6247 Connect with this product @ www.readershop.com/mpc0401 | 877.751.7467 ID#0401**

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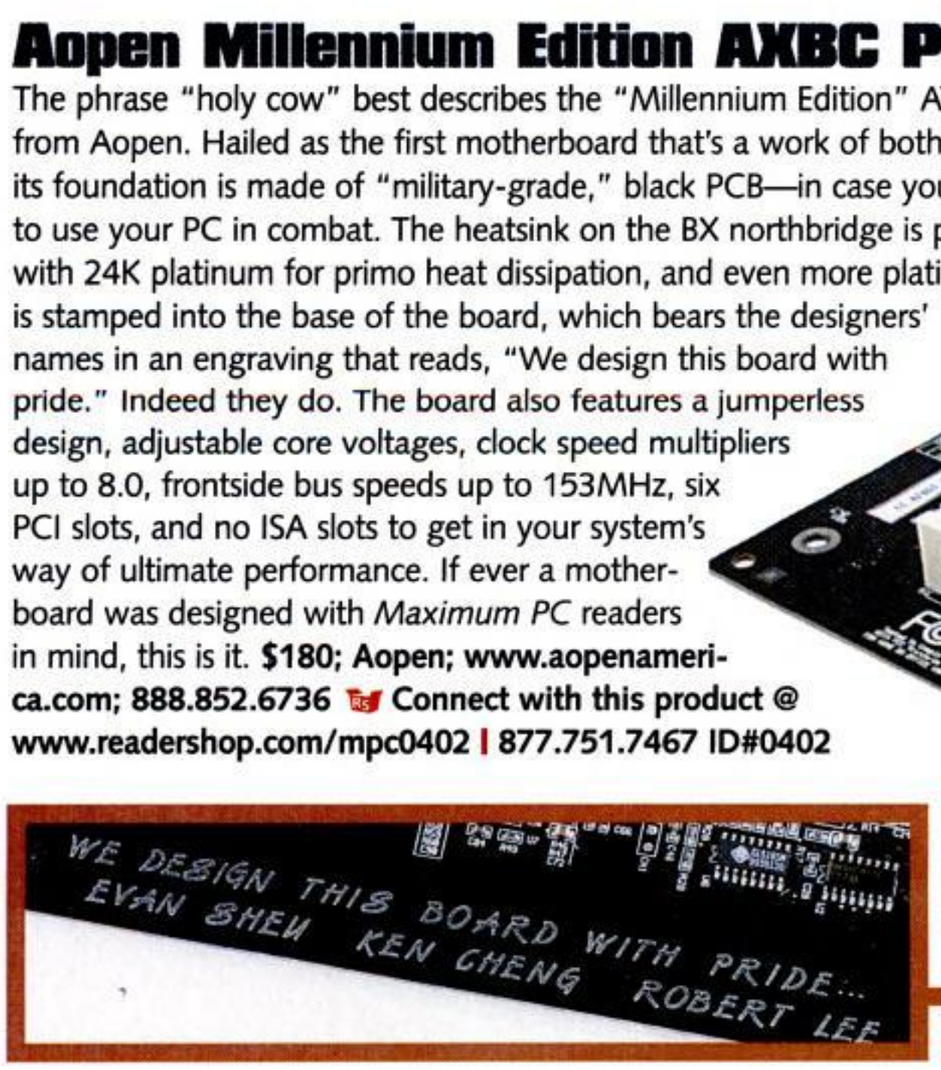
The phrase "holy cow" best describes the "Millennium Edition" ATX motherboard from Aopen. Hailed as the first motherboard that's a work of both art and science, its foundation is made of "military-grade," black PCB—in case you ever need to use your PC in combat. The heatsink on the BX northbridge is plated with 24K platinum for primo heat dissipation, and even more platinum is stamped into the base of the board, which bears the designers' names in an engraving that reads, "We design this board with pride." Indeed they do. The board also features a jumperless design, adjustable core voltages, clock speed multipliers up to 8.0, frontside bus speeds up to 153MHz, six PCI slots, and no ISA slots to get in your system's way of ultimate performance. If ever a motherboard was designed with *Maximum PC* readers in mind, this is it. **$180; Aopen; www.aopenamerica.com; 888.852.6736 Connect with this product @ www.readershop.com/mpc0402 | 877.751.7467 ID#0402**



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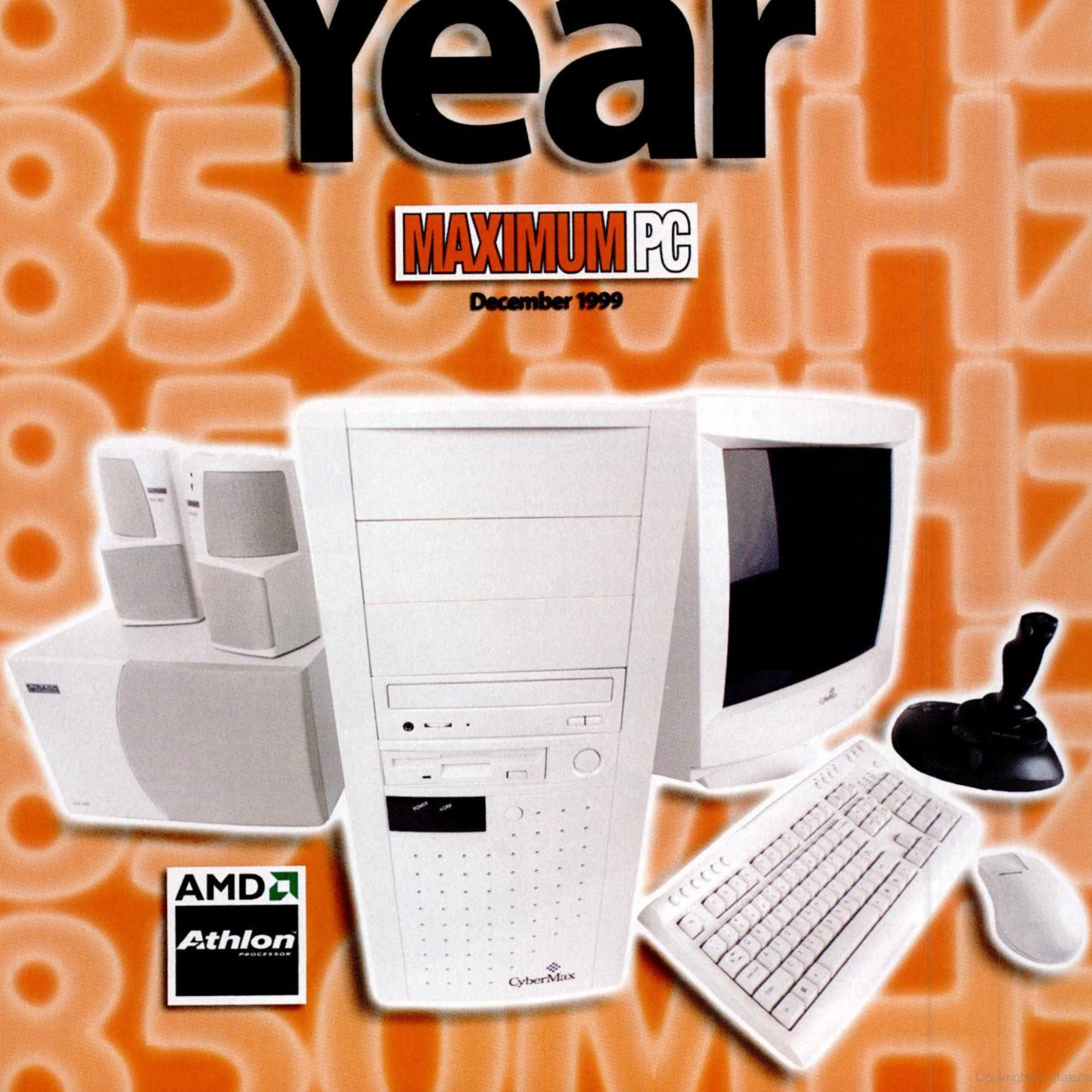
System of the Year

MAXIMUM PC

December 1999



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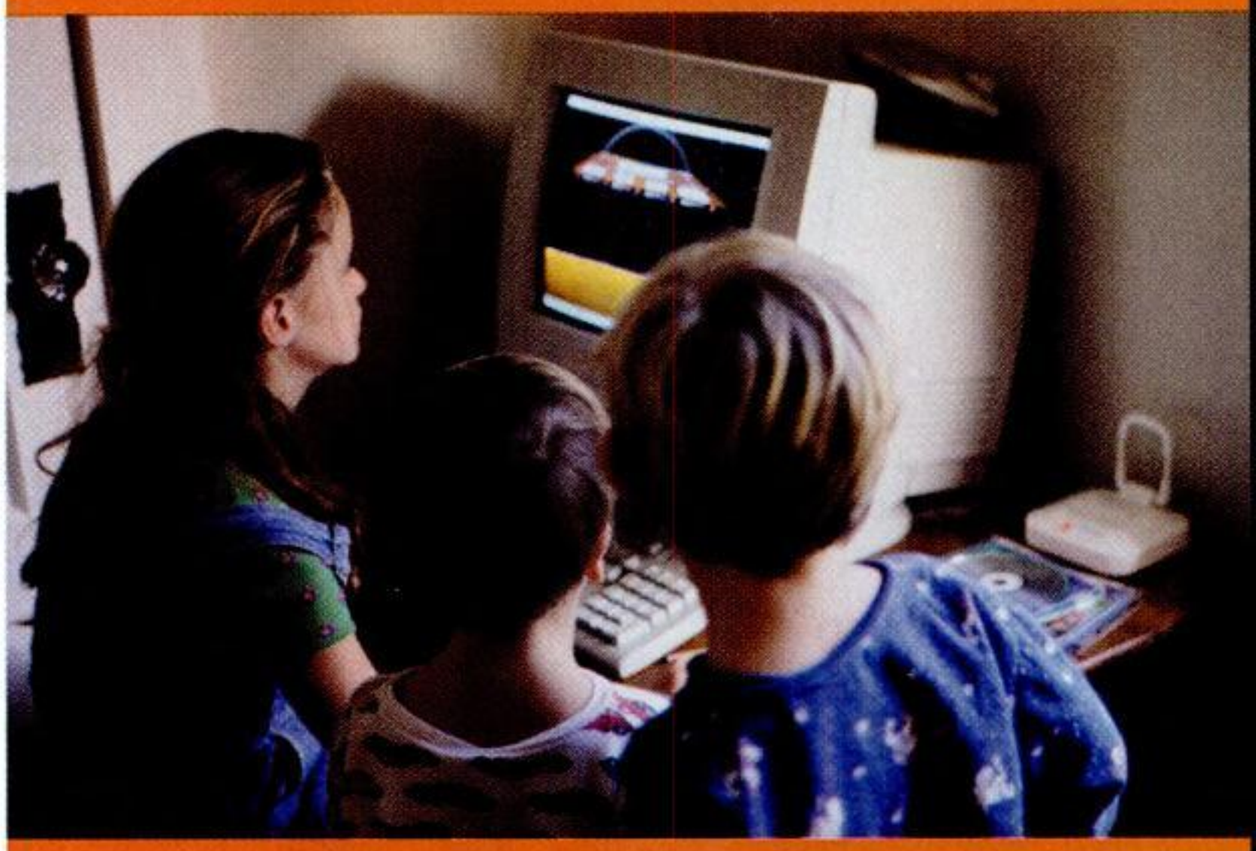

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▶ TOMORROW'S TECHNOLOGIES EXPLAINED

FAST FORWARD

When Good PCs Go Bad

HOW TO PREPARE FOR THE INEVITABLE FATAL HARD DRIVE CRASH

Maybe my home computer was so terrified by the possibility of Y2K bugs that it committed suicide. Or maybe it was tired of insults—it was only a 200MHz Pentium, so according to a recent *Maximum PC* editorial, it was "a prime target for flaming dung." Or maybe it grew weary of downloading the hundreds of unsolicited e-mails I receive hourly that promise to make me rich, successful, and irresistible to women.

Whatever the reason, my home computer suddenly died, just two weeks before the Y2K apocalypse was supposed to end life as we know it. One night, I switched on the machine and heard a terrible racket emanating from the boot drive. No, it wasn't an MP3 of Ricky Martin. It was the kind of sound you never want to hear from a disk drive—a death rattle that signaled a genuine hardware problem, not a simple software snafu that Mr. Norton could fix. After much wheezing, the plucky machine finally booted into Windows, but it expired shortly thereafter. The computer was so inert that a political action committee donated some money to it, mistaking it for Al Gore.

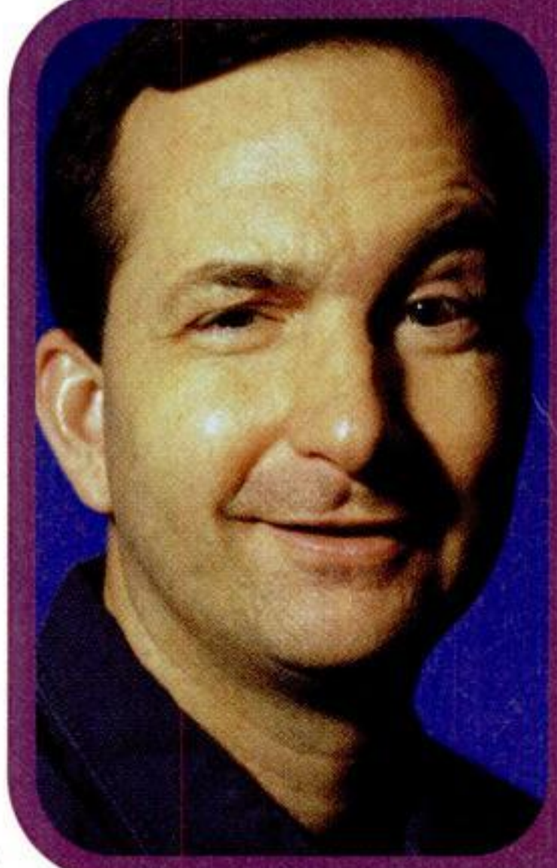
I've never had a computer utterly die on me like this, even though I've been using computers since George W. Bush had disco fever. I humbly offer the following lessons in case a similar disaster happens to you.

Lesson 1: Make regular backups. I had a backup image of the failed drive on a CD-RW, but it was months old and not worth restoring. Fortunately, I had copied all my important data files onto a second hard drive only two days before the crash. But because the main drive had failed, I was faced with the tiresome task of replacing the drive, reinstalling Windows and all my software, and bringing the system back to its highly tuned state. It's the same amount of work as setting up a new machine.

Lesson 2: A repair job is an opportunity to upgrade. I hadn't planned to upgrade for another year, because my Pentium 200 was still fast enough for nearly all my software. (I'm not a gamer, and that makes a huge difference in how much horsepower a PC requires.) The only software that made me yearn for a faster system was *CoolEdit*, a sound editor. *CoolEdit's* noise-reduction filter sometimes took 25 minutes to process a big WAV file on the Pentium 200. So I decided to upgrade now, rather than waiting another year.

One night, I switched on the machine and heard a terrible racket. No, it wasn't an MP3 of Ricky Martin.

My system isn't a brand-name box; it's custom-built. Salvageable parts included the ATX case, power supply, second hard drive, CD-RW drive, and floppy drive—not to mention, of course, the Sony 200ES monitor and ergonomic keyboard. My Asus TX97 motherboard had to go because the fastest CPU it could handle was a Pentium 233. The TX97 had built-in audio, so I needed a new soundcard, too. Ditto for the graphics card, a Diamond Stealth 2500: It was a PCI device, and any new motherboard will have AGP.



TOM HALFHILL
was senior editor at *Byte* magazine and is regarded as one of the most knowledgeable experts on processor technology in the industry. Contact him at **thalfhill@maximumpc.com.**

Lesson 3: Buy for your needs, not for your greed. Here's what I got: a 600MHz Pentium III, because I need that much power to push *CoolEdit* through those big WAV files; an Asus P3B-F motherboard, because Asus makes good mobos and I wanted four DIMM slots; two Kingston 64MB PC100 DIMMs, because I feel safer with brand-name memory; an IBM 9.1GB 7200rpm IDE hard drive, because it was the smallest drive at the store, and my old 2GB drive was only half full when it broke; a SoundBlaster Live! Value card, because it was on sale and it accepts a daughtercard with digital-audio inputs; and an old Matrox Millennium G200 graphics card, because it was abandoned in a junk drawer at the office, and nongamers don't need anything faster.

Lesson 4: Organize your software. I've always envied the bundled-software CDs that come with brand-name PCs, so I created my own. I burned a bootable CD-RW that contains Windows 98 and the installers for my most important apps and utilities, plus text files with the serial numbers of my registered shareware. Not everything fits on this CD, but I can reinstall 80 percent of my software from one disc. I'll update it periodically—and pray I won't need to use it anytime soon.

Random Thoughts

▶ Some PCs and devices that survived the Y2K problem may fall victim to the millennium leap-year bug—the failure to recognize 2000 as a leap year. Normally, years ending in "00" are not leap years unless they are divisible by 400. You can work around the problem by resetting the date after February 29.

▶ As the presidential race heats up, watch for candidates to advocate a stronger rating system for electronic games. School shootings make this a hot-button issue, and most game players don't (or can't) vote.

▶ Want to see the future of computer graphics? Don't miss Disney's *Dinosaurs*, a movie coming out this spring. Based on early previews I've seen, it's got the best computer graphics to date, surpassing even *Toy Story 2* and *Jurassic Park*.

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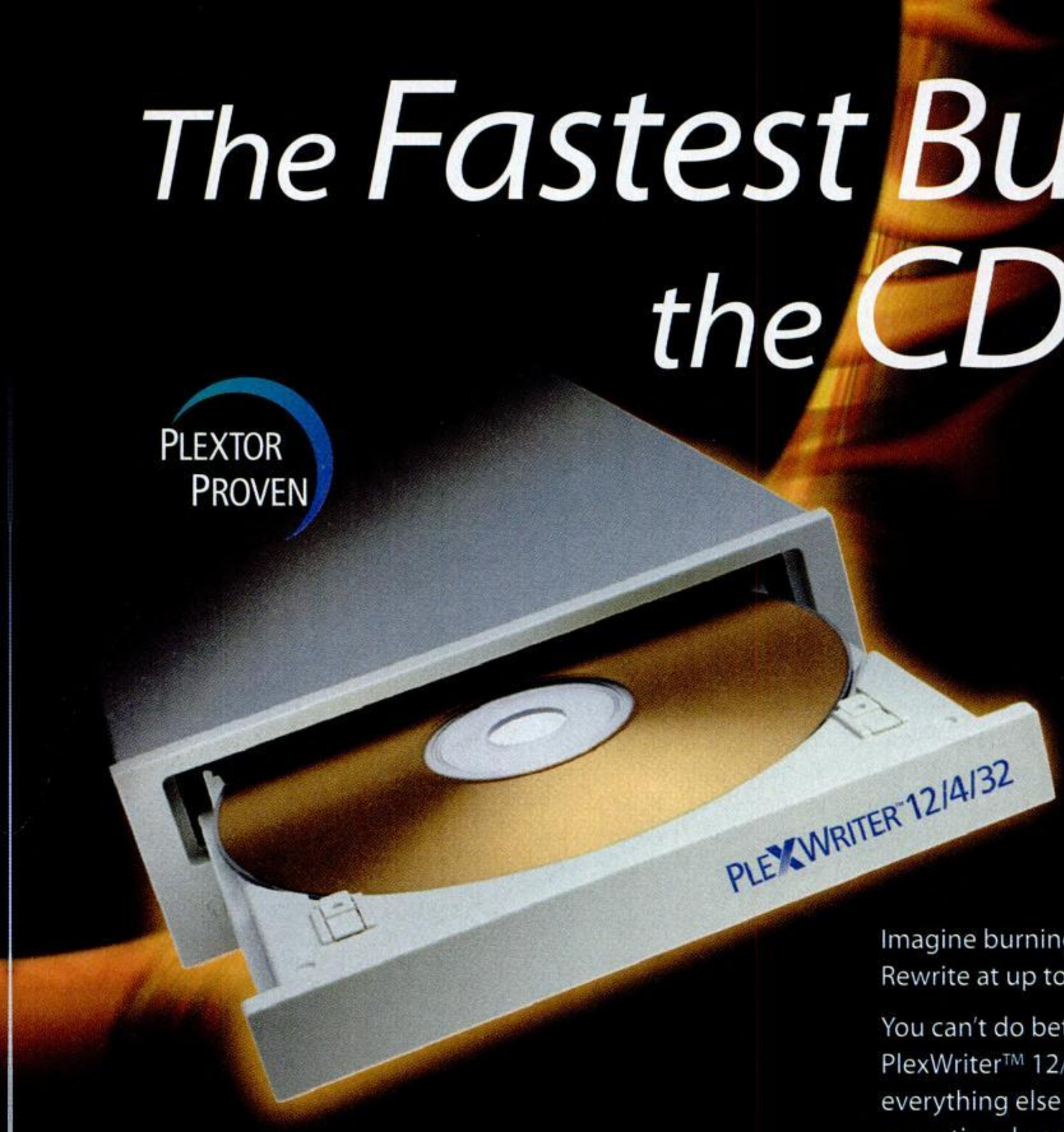

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▶ THE SCOOP FROM A MAJOR PLAYER

GAME THEORY

We're All Sick

HOW TOUGH HAVE YOU MADE LIFE FOR YOUR SIMS?

Comedy is when *you* fall off a ladder. Tragedy is when *I* fall off a ladder.

Or so they told me in film school. The pain regularly inflicted by Mo upon Curly would be horrifying if it ever happened to us, or even if it happened in front of us to someone else. Yet in the safety of the two-dimensional realm, you have to admit that cruelty can sometimes be pretty damn funny—which brings us to *The Sims*, and all sorts of troublesome moral questions. *The Sims* is *SimCity* taken to an individual level, as you control the lives, loves, fortunes, and fates of average burbanites like yourself. Though it's a formless anti-game that lacks a conventional beginning, middle, and end, *The Sims* is obscenely addictive. And quite, quite twisted when it falls into the wrong hands.

The world of *The Sims* seems benign enough: You try to increase the happiness and wealth of your little people. Or do you? Like another, far-inferior life sim called *Creatures*, the first order of business for every single person I know wasto see how horrid you could make life for your minions. With *Creatures*, you could starve and beat the little guys into dysfunctional wrecks, which was pretty much the only redeeming feature of the game. In *The Sims*, it can get much weirder. These are, after all, "people" who share the same banal hopes and desires we all do.

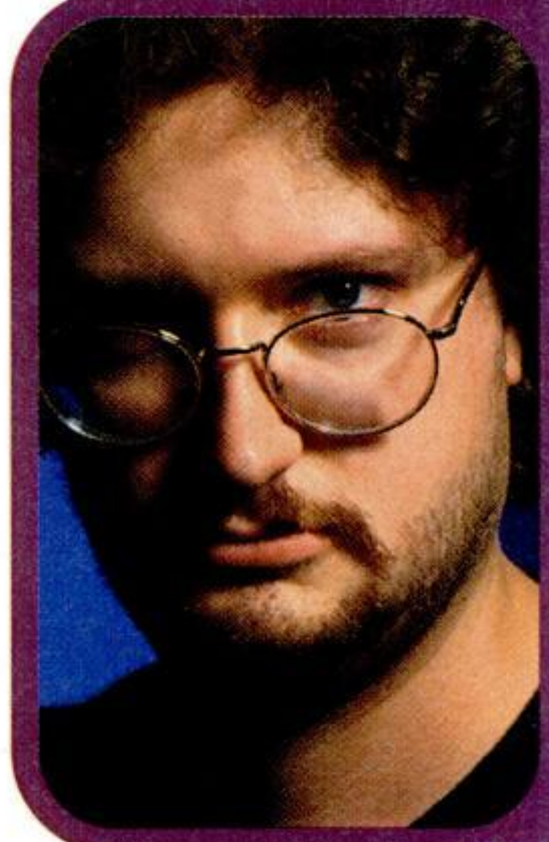
How deep into everyday life does this thing probe? Pretty damn far. However, after discovering that couples never have sex and are shielded by a discreet mosaic during showers and toilet visits, my first order of business was to break up my sim couple's marriage. When the ever-preset neighbors, the Goths, dropped by, it took only a little persistent clicking to involve the sim wife in a torrid affair with Mr. Goth. Doing this in front of Mr. Sim had a remarkable effect. A few passionate kisses and Mr. Sim was an utter wreck: missing work, watching cartoons in his pajamas all day, leaving garbage on the ground, losing bladder control, and screaming in rage at random moments. He even set the house on fire. This was much more twisted than I had hoped.

I even watched a sim burn to death and end up in a little urn. This upsets the surviving sim for awhile, but soon he or she is back, flirting with a neighbor at a barbecue. Life, or a reasonable facsimile, goes on.

So, you can wreck a marriage in a sim, but what about homosexuality? Turns out two men can move into a house and, with some encouragement, fall in love, kiss, and share a bed, thus shattering one of the last and largest taboos in computer gaming. They can't get married (this isn't Hawaii, you know), but they do everything else. This is bound to elicit some response from moral watchdogs, and Maxis is probably counting on this to fuel the hype. I won't try to fathom the reasoning behind the inability to make partners divorce, and the polygamy that subsequently arises, but it seems strangely natural in *The Sims* weird little world.

Sim children are particularly hard to handle. Babies grow up fast, but need constant attention during their formative years or Social Services will whisk them away. If your children aren't well-fed, happy, and attending school, off they go to the orphanage.

If you think your character is tired of the same old grind, choose a life of crime and work your way up to mob boss. I even watched a sim burn to death and end up in a little urn. This upsets the surviving sim for awhile, but soon he or she is back, flirting with a neighbor at a barbecue. Life, or a reasonable facsimile, goes on.



T. LIAM MCDONALD
is a veteran gamer and game writer. His reviews appear regularly in *PC Gamer* and other publications. Write him at **tmcdonald@maximumpc.com.**

Happy sims bother me, and totally messed-up sims are too hard to control, so my ideal sim is slightly screwed up but trying—like me. I love to inflict tortures on the characters, and while this may say more about my personality than it does about gamers in general, I know a lot of you are the same way. Every friend who asked me about *The Sims* before it hit the stores wanted to know the same things. Can you screw with their heads? Can you kill 'em?

Maybe we like playing god, and misery seems to be god's *mot juste*. Maybe we like to see people whose lives are more screwed up than our own (which would also neatly explain the popularity of Jerry Springer's show). Maybe all those mornings in front of The Stooges really did make us numb to the pain of others, particularly two-dimensional others. Maybe, as Nietzsche said, "Almost everything we call 'higher culture' is based on the spiritualization and intensification of cruelty." Or, to quote another expert on the subject, the Marquis de Sade said that cruelty "is the first sentiment Nature injects in us all .. the energy in a man [that] civilization has not yet altogether corrupted. Therefore, it is a virtue, not a vice."

Or maybe we're all just sick bastards. ✹

Random Thoughts

▶ **Hoppin' Mad:** I'm getting my ass kicked on *UT* because the hardcore players have mastered the jump-n-shoot. *UT* servers are like a visit to a kangaroo farm. If you plan to spend any time out in the thick of it, practice your jumps offline or you're hosed.

▶ SWAT 3: Sierra will soon release the free EXE that adds co-op SWAT multiplay to the game. The add-on disc Battle Plan will follow, with deathmatch, AI leadership, and terrorist multiplay modes, as well as six newmaps. Multiplayer, along with the AI fixes, will make this an all-time classic.

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WIN2000 ON TRIAL

Microsoft's workstation OS is more friendly than ever—but is it gamey enough for power users at home? The scrutiny of cross-examination reveals all the sordid details...

BY WILL SMITH

The Accused: Windows 2000, successor to Windows NT 4 and the first workstation-level OS from Microsoft to offer legitimate DirectX support.

The Charge: Offering hardcore home power-users a better alternative to Windows 98.

The Evidence: Superior features and stability.

On the following pages, we'll detail the benefits that Windows 2000 Professional Desktop brings to the table, along with the drawbacks that could compel someone to stick with Win98. In this courtroom, *Maximum PC* plays prosecutor, defense attorney, judge, and jury—but you at home determine sentencing. If, after reading all the evidence we compiled during discovery, you decide to drop Win98 for Win2000, go to **www.microsoft.com/windows2000/upgrade** for the latest information on the switch. An OS upgrade shouldn't be taken lightly; be sure you know what you're getting into before you take the plunge.

ILLUSTRATIONS BY ISMAEL ROLDAN

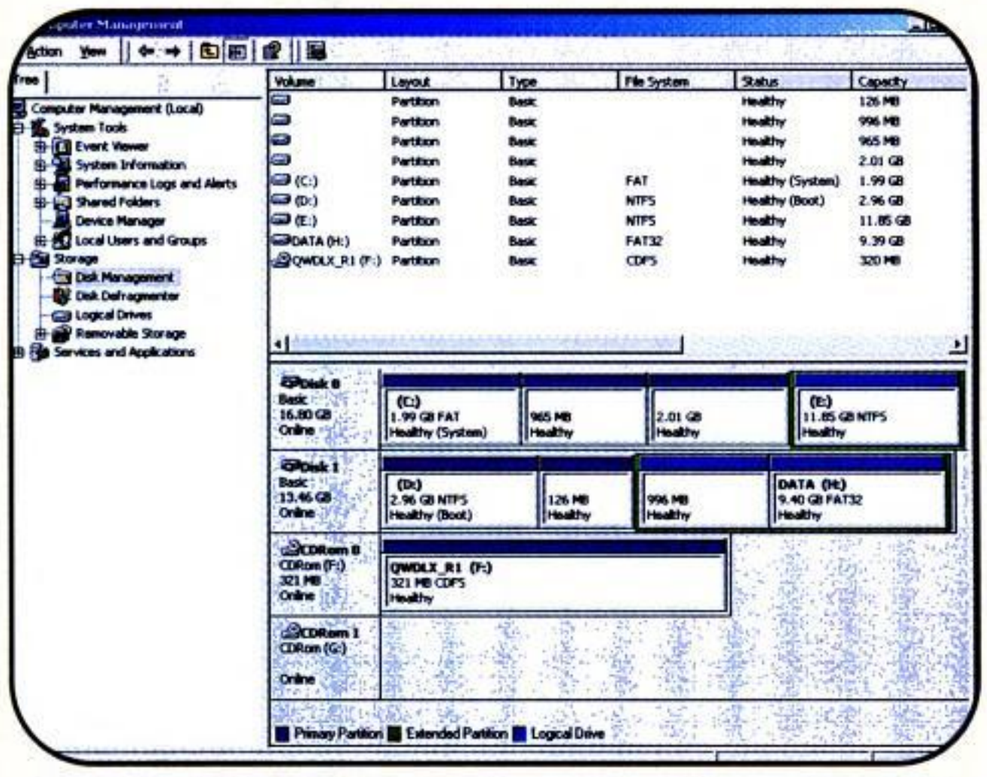
Windows 2000

Opening Arguments

When Windows 2000 was first announced in October 1998, it was to be the convergence of two operating system families: the Windows 95/98 line and the Windows NT line. Win95/98 has always been targeted at home consumers, while NT has been directed at workstation geeks and cubicle drones. Win95/98 is rooted in Windows 3.1, a 16-bit OS; support for 32-bit applications was tacked onto the legacy code when Win95 was released. NT, meanwhile, is a pure 32-bit OS; it is incapable of running 16-bit applications. NT also includes a Hardware Abstraction Layer (or HAL) that sits between the OS and the hardware, insulating the PC from bad drivers and nasty software errors that can cause hard system crashes.

Unfortunately, one of NT's best features has also been one of its greatest design hurdles. DirectX was designed to give applications direct access to your PC's hardware, bypassing the OS entirely in order to improve gaming and multimedia performance. But the HAL has never liked DirectX—after all, giving software direct access to the hardware is specifically what the HAL was designed to prevent. Naturally, there were serious problems getting DirectX (specifically Direct3D) to work in NT. Microsoft eventually decided to give up on the idea of NT and DirectX playing nice-nice; NT dropped DirectX support shortly after DirectX 3.0 was released.

Flash forward to 1999: Microsoft decides that the Windows 95/98 line will survive one more generation in the form of Windows Millennium Edition (WinME). WinME is slated to be a bozo-proof version of Windows, and is scheduled to woo witless newbies during the second half of 2000. So where does this leave Win2000? Well, after retooling the HAL to allow DirectX access, Microsoft now has a 32-bit OS with an upgrade path from not only NT 4, but also Win95/98. With the introduction last month of Win2000, the reasons a power user might reject Win2000 for all of his computing needs may be dwindling.



Win2000's Disk Administrator lets you kiss fdisk goodbye. While it will perform all the vanilla tasks that fdisk did, it also lets you stripe and mirror your disks without using any RAID hardware. It'll even show you the sizes and location of your Linux and BeOS partitions, and let you reassign drive letters.

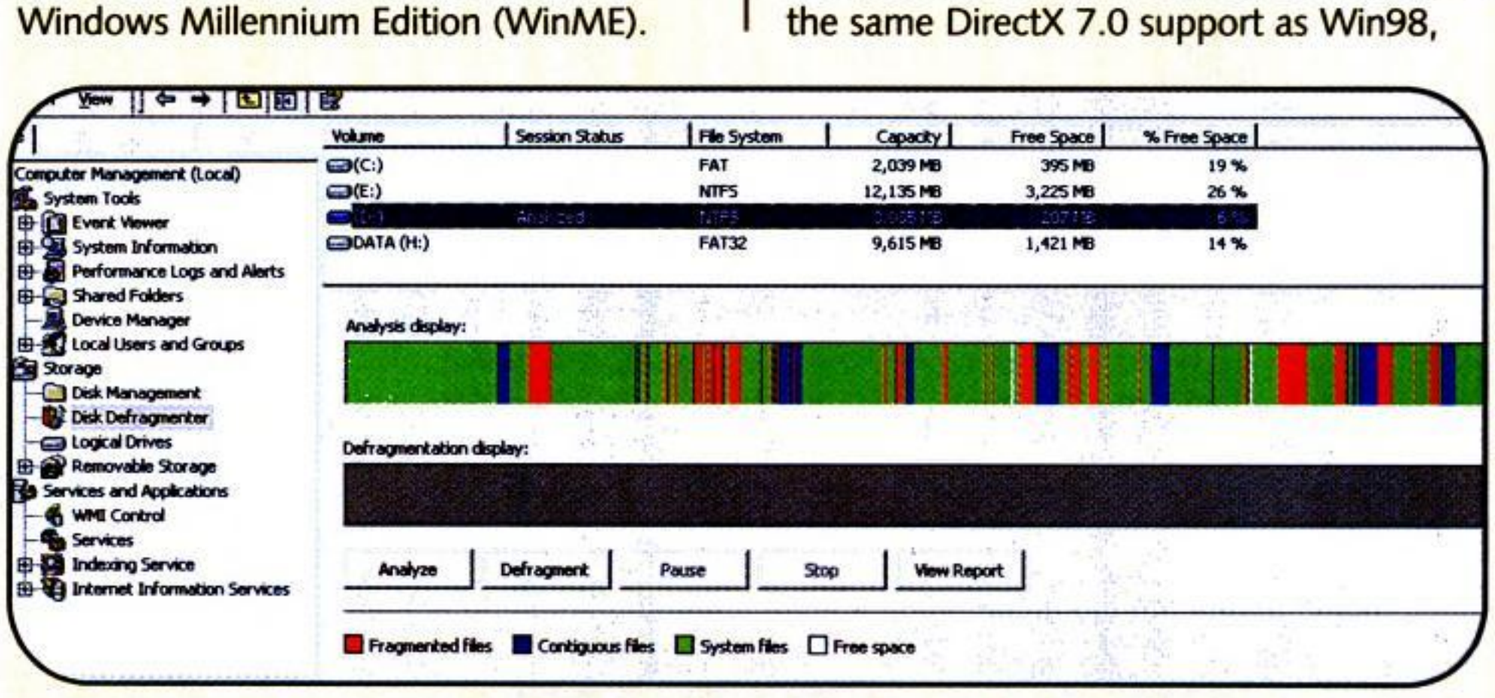
Please be aware that Win2000 comes in four flavors: the desktop version (which is under indictment in this article), and three server versions that are wholly inappropriate for home use. If you're upgrading from Win95/98, Win2000 Desktop will cost you $219. If you're upgrading from WinNT 3.51 or 4.0, it will cost you $149 after a $70 rebate. Win2000 Desktop costs $319 if you're starting from scratch.

Exhibits A through N

Win2000 is a hybrid OS. It's based on the NT kernel, but contains some Win98 features, such as DirectX and Plug-and-Play support. Witness the tricks—some old, some new—that Win2000 brings to the table:

Full DirectX Support Win2000 promises the same DirectX 7.0 support as Win98, including full Direct3D support. This means that all your favorite Win95/98 games will work in Win2000 exactly as they did in Win95/98. They should even take advantage of whatever 3D accelerator you have in your system. Of course, accelerator support is completely dependent on hardware vendors releasing decent drivers for their cards.

How does DirectX mitigate the HAL? Getting a straight technical answer from Microsoft is next to impossible, but a Redmond spin doctor told us, "The Windows 2000 HAL was extended to include DirectX calls to the device drivers. So it's kind of the best of both worlds... You have the hardware acceleration, but it's done in a protective manner." Obviously, this shallow answer does not please the court! Nor does it satiate the *Maximum PC* reader's thirst for technical insight. Rest assured, we'll press Microsoft for more information in the coming months.



Win95/98 always came with some sort of disk defragmentation tool, but NT users had to buy a third-party utility for the same level of disk lovin'. Not only does Win2000 come with a disk defragmenter, but it's actually a lite version of Executive System's excellent *Diskkeeper*.

Plug-and-Pray No More! Win95/98 users take Plug-and-Play for granted, but NT users have lusted forever for this feature. See, whenever you install a new piece of hardware in your NT box, you must manually tell the computer that something is new. As if that isn't bad enough, there's no Device Manager in NT. Thankfully, Microsoft has finally gotten Plug-and-Play right in 2000. You can even install new Win2000 drivers without a reboot—even for your videocard.

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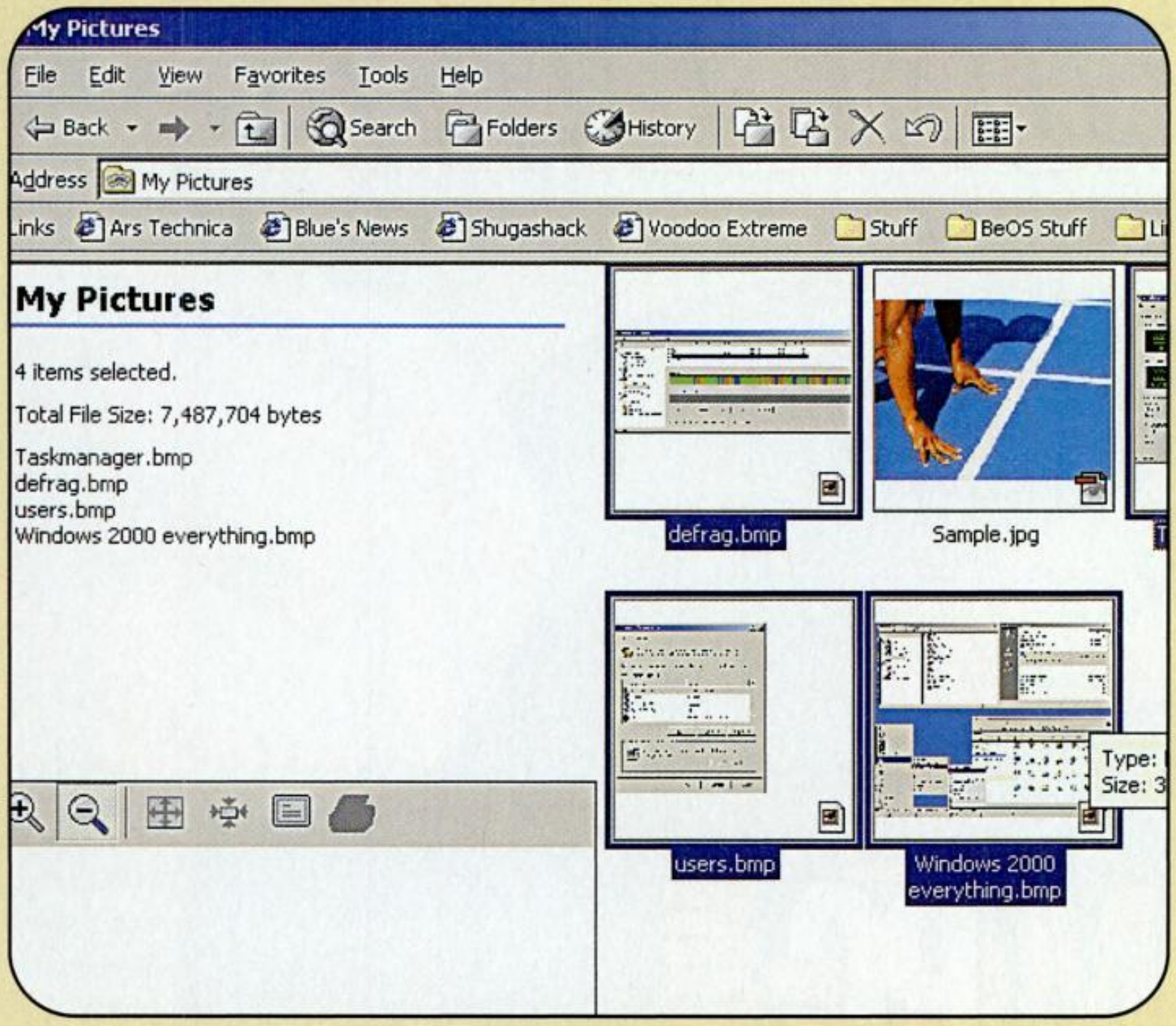

Win2000 features a handy thumbnail option to make viewing images much easier. To activate it on a per folder basis, just select View, Thumbnails.

Easy Upgrade from 98 to NT Win98 users who wanted to make the move to WinNT 4 were forced to format their hard drives and reinstall a fresh copy of the OS onto an empty partition. Thankfully, the upgrade from Win98 to Win2000 is relatively painless, especially if you take the time to verify that all your hardware is supported by 2000. One word of warning, however: The Win2000 upgrade program refuses to upgrade 98 to 2000 if you have any non-Microsoft partitions on your computer. Linux and Be users, you have been warned.

Multi-Monitor NT 4 doesn't support multiple monitors. Win98 does, and so does Win2000. If you're in the market for a larger monitor, consider getting a second monitor that's more or less the same size as the old one: Two 17-inch monitors have more display area than a single 21-incher. All you need is an additional PCI video card and a second monitor. Just be sure that the PCI card you purchase supports multimonitor; some older chipsets don't work properly.

Interface Changes Win2000 includes the browser metaphor-based UI changes that *IE4* and Win98 introduced, but also implements the expandable menus introduced with Office 2000. In all Explorer applications, including the Start Menu, you can choose to see only the apps that you use on a regular

In order to take advantage of Win2000's excellent security features—such as user disk space quotas and separate browser and mail profiles—you'll need to set up accounts and privileges in the User Manager.

basis. There are also new cosmetic features, such as fancy new transparent menus.

USB The NT family finally includes native support for USB. We tested Win2000's USB support extensively, trying everything from game controllers to digital cameras. We discovered that Win2000 has solid USB foundations, but support for individual devices is entirely dependent on the quality of the drivers provided by peripheral manufacturers.

Symmetric Multi-Processing Dual-processor systems and motherboards are cheaper than ever. And who wouldn't want to explore the do-it-yourself SMP lovin' enabled by the Abit BP6 mobo and two Celerons running in tandem? Thanks to its NT legacy, Win2000 supports dual-proc action, something that Win98 and WinME users will never enjoy.

Multi-user Support You and your kids share a computer, but you don't want Junior accidentally stumbling upon Paula's Porn Palace if he noses through your browser cache. Thanks to Win2000's user profiles, Junior won't be able to get into your cache if you configure the system properly. And that's only the beginning: Win2000 includes a host of security features that prohibit "unauthenticated users" from using various system and network resources (specific applications, printers, etc.). Win2000's security model is strong enough for major corporations and the military, so shouldn't it be strong enough for you? Oh yeah: You can't bypass the security login simply by pressing the cancel button, either.

Kernel mode write protection Woo-hoo! Kernel-mode write protection is something that WinNT had way before it was cool (and something Win98 still doesn't have). An OS's kernel is the core code that runs the PC, handling all the basics, such as disk I/O, memory access, and CPU allocations. Like its predecessors, Win2000 protects the vital areas of RAM that hold system data, allowing you (in most instances) to resume working after a crash without having to reboot.

System File Protection Win2000 includes the System File Checker that

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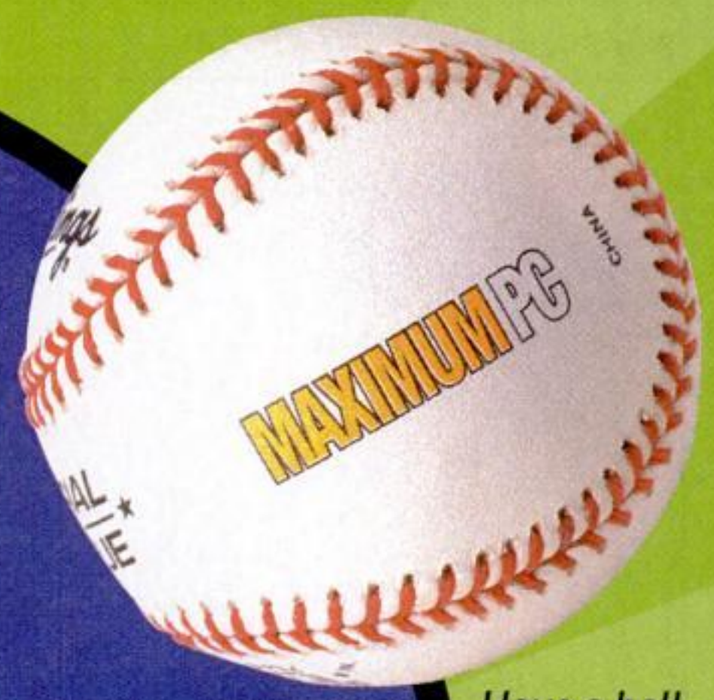

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ships with Win98. This tool allows you to replace files that have been deleted or modified, using the original versions from the installation CD.

Power Management Notebooks running NT4 are notorious power hogs, consuming twice the battery juice of similarly configured hardware running Win98. Thankfully, Win2000 takes full advantage of the Advanced Configuration and Power Interface (ACPI) to control power flow to every component in your system, maximizing battery life.

Better Networking Networking has always been one of NT's strong suits, and this carries over into Win2000. Serious online gamers will definitely benefit from the efficiency of the NT TCP/IP stack. Reports of 10 percent improvements in ping times aren't unheard of when people upgrade to NT, and the same should hold true for Win2000.

One of NT's biggest problems has been network configuration, which has always been needlessly difficult. Win2000 adds a tasty candy shell to the whole process. This should smooth network configuration for people who aren't network engineers, but leave NT's powerful features uncompromised for those who are. Another handy feature making its first appearance in an NT-based OS is Internet Connection Sharing, which debuted in Win98 SE. ICS allows you to seamlessly share one net connection among a bunch of machines, using NAT (Network Address Translation).

DVD Playback Win2000 includes the same anemic DVD support that Win98 SE has. You bring the decoder (software or hardware); Windows supplies the interface. We always thought DVD support meant that you had a drive, you had a disc, and it simply worked. Maybe in Win2002?

FAT32 support Win2000 is the first Microsoft OS to offer support for all of Microsoft's own file systems. With Win2000, you can finally read both native NTFS partitions and the FAT32 partitions that Win98 is fond of.

Cross-examination

On paper, Windows 2000 appears to be a model citizen—but how well does it withstand *Maximum PC*'s prosecutorial lash? Here are the answers to the toughest questions.

Will all my hardware work in Windows 2000? Probably. Hardware support depends on both the hardware vendor and Microsoft. To find out what's supported with drivers directly from the Win2000 CD, check the Windows 2000 Hardware Compatibility List (HCL) at **www.microsoft.com/windows2000/upgrade/compat/search/**. Of course, this isn't the end-all, be-all list. After Win2000 is officially unleashed, it will be up to the hardware vendors to release new drivers. If you bought your system within the past three years, your hardware will probably be supported.

If your hardware doesn't appear on the online list and you can't find Win2000 drivers for your parts on the hardware vendors' web sites, try using existing NT4 and Win98 drivers as a last resort. Traditionally, NT and 95/98 drivers are as different as 95/98 and Linux drivers, so vendors must write completely separate drivers for 95/98 and NT. Nonetheless, we've had some success getting otherwise unsupported hardware to work using this trick. Just one caveat: While some Win98 drivers will work in Win2000, Win98 *videocard* drivers will *never* work in Win2000, and may royally bork your system. Beware!

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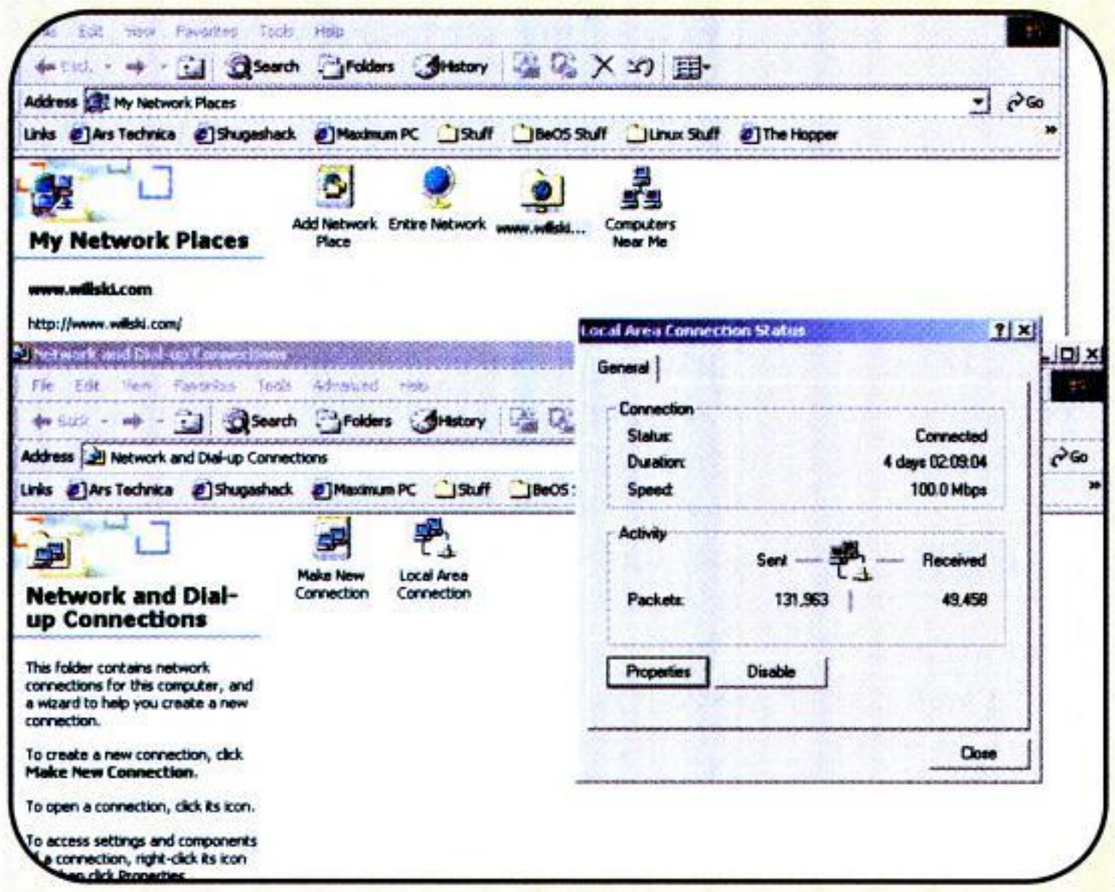

NT4's Network Neighborhood has been totally revamped. The new design is based on usage, rather than proximity, and makes your web site hosted across the country as easy to access as the network share down the hall. Still present are the handy stats about network usage.

Will all videocards work in Windows 2000? Win2000 is shipping with basic support for most popular videocards made in the past few years. Let's face it, though: You aren't satisfied with basic support. You want pixel-pounding 3D acceleration, for both Direct3D *and* OpenGL games. For this, you must rely on driver support from individual chipset and videocard manufacturers.

By the time you read this, 3dfx and nVidia should already have Win2000 Direct3D and OpenGL drivers for their latest chipsets. Full Matrox drivers are imminent. ATI and S3 drivers are questions marks. At press time, ATI told us it would have an announcement on February 17 (Win2000's release date). S3 simply didn't return our calls and e-mails.

Even if your videocard manufacturer isn't totally on the ball when it comes to Win2000 drivers, you aren't totally out of luck. If your card has WinNT 4 drivers that support OpenGL, you'll be able to play any OpenGL-accelerated game that you'd play in NT4. However, if you have to use NT4 drivers, some of your card's more advanced features—such as TV-out, video capture, and hardware-accelerated video playback—may not function.

Will all my peripherals work in 2000? Some will, some won't. If a piece of hardware is on the HCL, you'll find drivers on the installation CD. If it's not on the list, finding drivers is your responsibility.

During testing, a Kodak DC265 digital camera connected flawlessly with software built into the OS, allowing us to download digital pics with ease. We also tested several Microsoft USB-based input devices, including the Intellimouse Explorer and the Dual Strike controller. As expected, all worked normally. For kicks, we even threw an old Hauppauge video-capture card into our test system. It performed flawlessly with drivers downloaded from the web.

Unfortunately, all is not bliss in the world of Win2000 hardware support. Some devices will stubbornly refuse to function properly. A Visioneer Paperport USB scanner insisted that Windows NT doesn't support USB, and wouldn't allow us to install either NT or 98 drivers. Ack! Fortunately, if your hardware is modern and was built by a responsible, reputable company, you should soon see Win2000 drivers for all your favorite gadgets.

What about soundcards? All the major soundcards are on the HCL. They do nothing more than provide basic sound, however. As drivers are revised, expect to see A3D, EAX, and DirectSound3D support for all your favorite soundcards.

What does Disk Administrator do? Win2000's disk admin tools allow you to partition, extend, stripe, and mirror your hard drives. In a nutshell, you can enhance the reliability or speed of your drives by spreading data across two or more physical hard disks. Sounds like RAID, doesn't it? Well, it's similar. The disk admin tools give you RAID-esque benefits without making you buy an expensive RAID controller. The tools work with IDE and SCSI hard drives.

The disk admin tools also let you mount a new disk as a folder within a pre-existing directory structure. This means that when you buy a new hard drive, rather than adding another drive letter to your system, you can access the partitions on your new drive as folders within one of your pre-existing drives. This Unix-style luxury saves you the pain of trying to migrate your apps from the old drive to the new one.

Must a game or application expressly say "NT support" or "Win2000 support" on the box, or can you install any Win98 app on Win2000 without any trouble? Most apps that run on Win98 will run without any problem on Win2000. The three main exceptions are 16-bit applications (no *Wordstar* for DOS, kiddies!), some system utilities, and some games. Software such as anti-virus utilities, memory defraggers, disk-partitioning utilities, or anything else that bypasses the OS to work directly on hardware may not get past Win2000's HAL.

Lots of older games are going to have problems in Win2000. None of your old DOS games will work, and some of your older Win95 games may not work. Some games even check to make sure you aren't running Windows NT (or Win2000). Your game may not function properly because the necessary hardware acceleration isn't present. If this seems to be the case, be sure you've installed the latest drivers for your videocard. The only sure-fire way to

Some people find them infuriating, but they're here to stay. Microsoft is definitely fond of the personalized menus that originally popped up in Office 2000. In fact, they're plugged directly into the Win2000 interface. Behold the most-used programs in our Start Menu.

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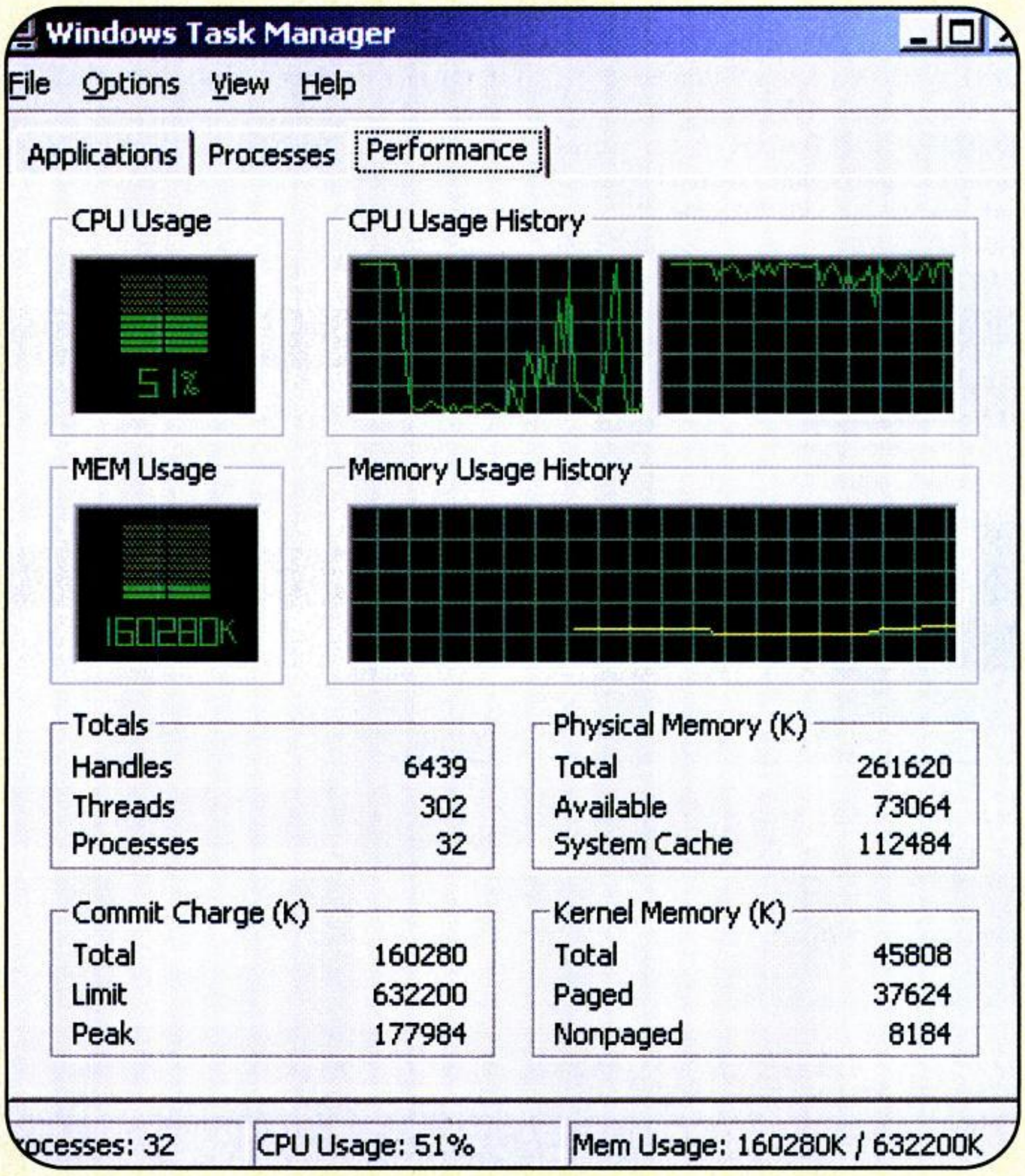


Win98 users have never seen the Task Manager, but it's an old friend to NT-philes. "Taskman" allows you to track the most vital of your systems stats, from memory allocation, to individual processes, to CPU usage. Here we have the CPU and memory usage of a dual-CPU system.

ensure a game will work is to check its packaging: If it says that it has NT support (or, even better, Win2000 support), it will work.

Does software simply run faster under Win2000? 32-bit applications should perform better than they do in Win98, but this doesn't necessarily mean they'll be faster. They may just be more reliable. For example, when your web browser chokes on some bad Java or JavaScript, it will be more likely to die a lonesome death instead of taking down your whole system in a mass murder-suicide.

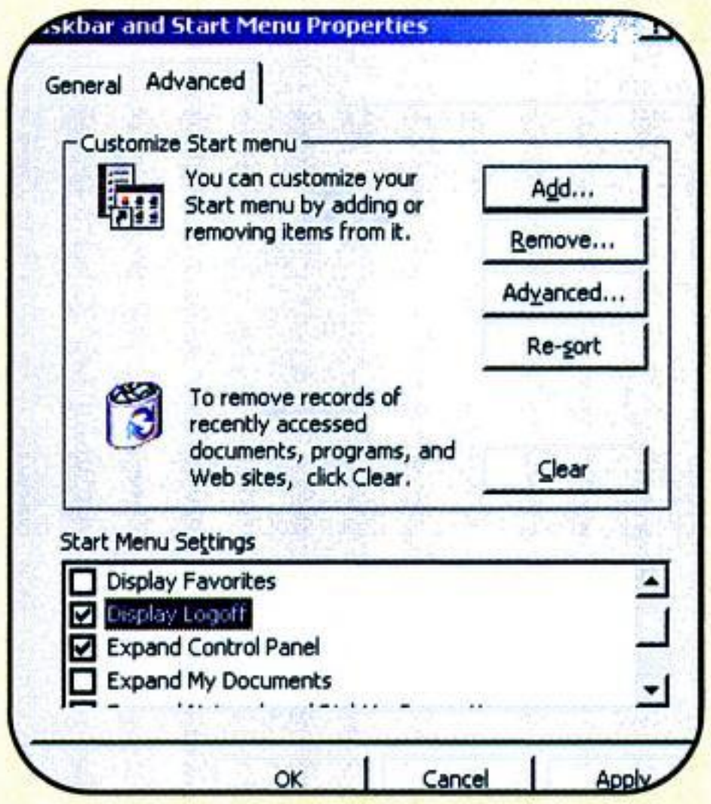
Of course, the added complexity of Win2000 means considerably more overhead. If your system already bogs under Win98, you will definitely suffer from decreased performance after the upgrade. See page 42 for Win98 and Win2000 performance comparisons. In general, we found that Win2000 can be a big, fat resource hog. Even Intel Vice President Pat Gelsinger says Win2000 needs 250MHz more CPU power than Win98 and WinNT 4. That's damning information from a long-time Microsoft partner, but then again, Intel does have chips to sell. Nonetheless, most industry vendors and analysts agree Win2000 does require more system resources than previous Microsoft OSes.

What parts of the OS present a learning curve? Win2000 is by no means dummy-proof. It's designed for workstation geeks and corporate environments. But *Maximum PC* readers know 10 times more about computers than the average corporate user, right? Our initial hunch is that anything that's "dummy proof" is going to be so invulnerable to human errors, it won't be any fun at all (if you wanted a computer you couldn't destroy, you'd have bought an iMac, right?). Some of Win2000's security features may be initially confusing to first-time users, but as long as you don't forget your Administrator password, you shouldn't have any major problems.

What special features are available in 2000, but not in 98 and NT? The old Win98 Add/Remove Programs dialog has been updated, and now reports how frequently you use each installed app, and when the last use was. Win98 users should also see great improvements in networking speed, thanks to the more efficient NT networking core. *FrontPage* users will love the tight integration with the OS, which allows you to browse any *FrontPage* web as if it were a folder on your computer.

NT user profiles and security features have also been updated. Each user profile has its own individualized version of the Start Menu, desktop, *Internet Explorer* bookmarks and cache, and mail files. When set up properly, each user will see only his or her own e-mail and bookmarks. Of course, anyone with administrator rights can see everything about everybody.

Continued on page 44



Ever wanted to get rid of the infuriating Favorites option from the Start Menu? With Win2000 you can finally nix it.

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Empirical Evidence: Win2000 vs. Win98

Windows 2000 is like a newborn colt bounding about on jello legs. Sometimes it sprints like the wind, and sometimes it takes a header into the rocks. In real-world testing, we found that the new OS offers only sporadic performance benefits over Win98. So if you're a Win98 user, upgrade for stability, not for faster benchmarks in consumer applications.

Some benchmark results were downright confusing. When performing a 3D rendering with Caligari *TrueSpace 4.3*, Win2000 and Win98 ran neck-and-neck with 256MB of memory and a single 500MHz Pentium III. But when we ran the multi-threaded application with two 500MHz P-IIIs in Win2000, *TrueSpace* actually rendered slower.

On the flipside, two procs *did* improve performance in SMP-enabled *Quake III Arena*. Win2000 frame rates improved when we popped in the second CPU. Nonetheless, even hot proc-on-proc action couldn't topple Win98's *Quake III Arena* performance. Running the game at 640x480, two processors in Win2000 begat 61fps, while a single processor in Win98 begat 77fps. Could the problem be rooted in nVidia's Win2000 OpenGL drivers? A source at nVidia said it ain't so, and pointed an accusatory finger at Win2000 itself.

SMP made a significant difference with the multi-threaded *Microsoft Media Encoder 4.0*. It ran nearly twice as fast in a dual CPU environment. Two procs also provided a noticeable performance boost in *Photoshop 5.5*, where a number of our filters asked both CPUs for help.

In general, Win2000, like WinNT 4.0, offers slight performance benefits over Win98 in standard office and productivity applications: With that 16-bit code stripped out for good, Win2000 beat Win98 in all of our SYSMark 2000 runs. However, the differences aren't as significant as what we've experienced with WinNT 4.0. We found that a 733MHz P-III running NT4 actually thrashed an 800MHz P-III running Win98.

—Gordon Mah Ung

	Win2000 SMP 128MB RAM	Win2000 SMP 256MB RAM	Win2000 single-CPU 128MB RAM	Win2000 single-CPU 256MB RAM	Win98 128MB RAM	Win98 256MB RAM
SYSmark 2000	114	114	109	109	108	111
Microsoft Media Encoder 4.0	63 sec.	66 sec.	103 sec.	107 sec.	105 sec.	104 sec.
Dragon Naturally speaking 4.0	161 sec.	172 sec.	166 sec.	174 sec.	157 sec.	156 sec.
Photoshop 5.5 (Maximum PC action script)	123 sec.	99 sec.	129 sec.	112 sec.	117 sec.	109 sec.
Caligari TrueSpace 4.3	178 sec.	149 sec.	156 sec.	131 sec.	136 sec.	131 sec.
MusicMatch 4.5 (MP3 ripping/ encoding)	388 sec.	383 sec.	384 sec.	403 sec.	323 sec.	320 sec.
Expendable	60.2 fps	56.7 fps	60.3 fps	58.6 fps	59.2 fps	59.3 fps
Quake III 640x480	61.4 fps	61.1 fps	48.7 fps	48.1 fps	76.3 fps	76.8 fps
Quake III 800x600	60.4 fps	59.9 fps	48.0 fps	47.9 fps	74.7 fps	74.7 fps
Quake III 1024x768	55.5 fps	55.3 fps	46.9 fps	46.5 fps	66.6 fps	66.6 fps

Test System: **Mobo** Iwill DS133R w/ Intel 820 chipset. **CPU** Two 500MHz P-IIIs used for SMP testing; one 500MHz P-III for all other testing. **Memory** 128/256MB Samsung 800MHz Direct RDRAM. **Videocard** Asus 6600 GeForce card with nVidia's reference 3.75 drivers on Win2000 and 3.68 drivers on Win98 SE. **Hard drive** Quantum Fireball ATA/66, partitioned into three sections. **Test Notes:** Best scores are printed in red. SYSmark 2000 runs 14 Windows applications through timed action scripts, and spits out a cumulative performance score; higher is better. In our other application tests, we record the time it takes to complete a standard set of actions; lower scores are better. Our gaming tests spit out frame rates; higher is better.

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Female Premiums

Age	10 YEAR	15 YEAR	20 YEAR	25 YEAR	30 YEAR
35	$ 295	$ 365	$ 465	$ 620	$ 720
40	$ 405	$ 530	$ 625	$ 800	$ 930
45	$ 615	$ 765	$ 895	$ 1,100	$ 1,320
50	$ 875	$ 1,080	$ 1,295	$ 1,560	$ 2,345
55	$1,305	$ 1,455	$ 2,035	$ 4,970	$ 10,060
60	$1,830	$ 2,250	$ 3,195	$23,585	$ 23,585
65	$2,875	$ 3,670	$ 5,055	$31,325	$ 31,325
70	$4,725	$ 6,655	$15,100	$39,905	$ 39,905
75	$9,955	$20,480	$41,580	$58,345	$ 58,345

Male Premiums

Age	10 YEAR	15 YEAR	20 YEAR	25 YEAR	30 YEAR
35	$ 325	$ 455	$ 545	$ 790	$ 950
40	$ 435	$ 665	$ 805	$ 1,150	$ 1,310
45	$ 735	$ 1,030	$ 1,295	$ 1,670	$ 2,010
50	$ 1,215	$ 1,665	$ 2,095	$ 2,550	$ 4,545
55	$ 1,875	$ 2,465	$ 3,060	$ 7,490	$12,520
60	$ 2,950	$ 4,285	$ 4,680	$31,815	$31,815
65	$ 5,030	$ 6,920	$ 8,955	$40,315	$40,315
70	$ 8,805	$11,715	$27,700	$53,235	$53,235
75	$15,755	$37,020	$52,860	$81,725	$81,725

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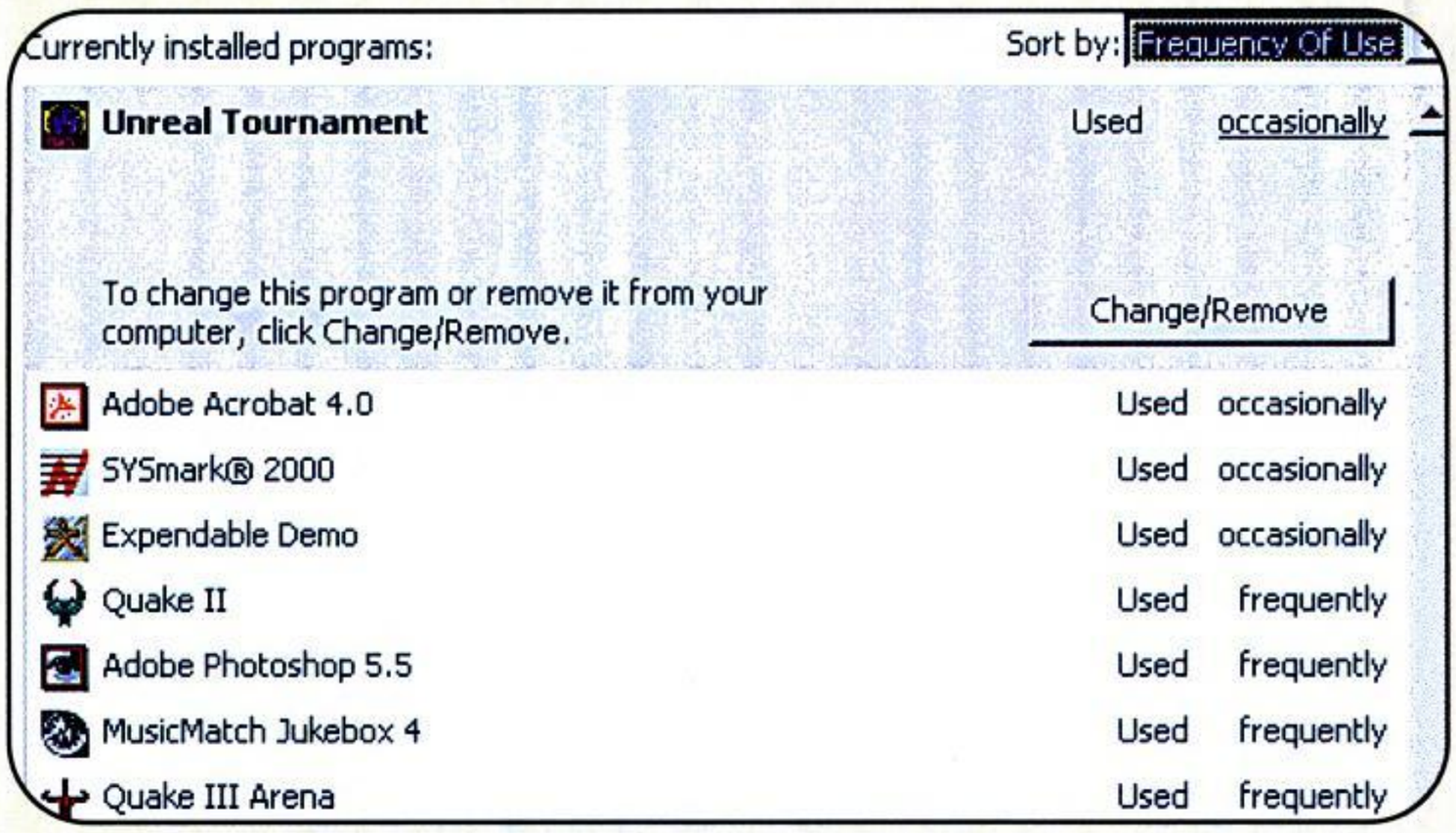

The Add/Remove software control panel shows how often you use different software.

In addition to two CPUs, what else do you need to realize the benefits of Win2000 SMP? SMP allows you to keep more applications open and fully exploit software that's optimized for multi-processor systems (a.k.a. "multithreaded software"). To take full advantage of two CPUs, you need at least two times the RAM you'd normally use; 256MB should be the minimum amount. In multi-proc systems, you can use the Task Manager to designate which applications are favored by which CPU. If you're performing CPU-intensive tasks that go on for hours and hours (scientific data analysis, for example), you can isolate that processing to one CPU, leaving the other CPU available for other tasks.

What games will offer dual-proc support? At press time, *Quake III Arena* was the only game available with SMP support. But while a game may not take direct advantage of SMP, it still may run better or faster on a dual-proc system. It's all about dedicating CPU cycles to a single intense activity. In a dual-proc system, one CPU can own system overhead, while the other can own a game's demanding 3D computations. Just be aware that the OS conducts a lot of its own activity, and will dump processes to the "other CPU" if the "first CPU" begins to bog down.

In informal *Quake III Arena* testing with SMP enabled, we found that a system containing two 450MHz CPUs boasted better overall frame rates than a system with a single 700MHz CPU. With SMP disabled, the dual 450MHz machine got frame rates comparable to a 500MHz machine. This test was hardly an apples-to-apples comparison, but it does hint at the benefits of SMP.

What are Win2000's basic system requirements? Microsoft's minimum requirement for Windows 2000 Professional is a 133MHz Pentium with 32MB of RAM. Hah!

I've never used WinNT before. What do I need to know before I upgrade my computer to Win2000? Three tips will make your life easier in the long run:

▶ When you partition the hard drive, install Win2000 on a small (3GB to 4GB) FAT32-formatted partition. There's no easy way to boot into Win2000 from a disk, and you won't be able to access your boot drive in an emergency if it's formatted with the NTFS file system.

▶ Always make a rescue disk before making serious hardware changes to your system. You can make a rescue disk by typing "rdisk" at a command prompt.

▶ Copy the i386 directory from the installation CD-ROM and put it in the root of your boot drive (usually C:). This directory contains everything you'll need to install Win2000 without the installation disk, and will keep you from needing the disk every time you install new hardware drivers or update the system. ✹

The Final Verdict

If you're currently running WinNT 4.0 and you're desperate for DirectX 7.0, USB, and Plug-and-Play, Win2000 Professional is a must. It's a simple upgrade and costs just $149 (for gamers, the DirectX support alone is worth the price of admission). Just be aware that all these new features add some paunch to the NT profile. Indeed, we found that Win2000 runs applications slower than WinNT 4, but if you're equipped with screaming hardware and lots of memory, the tax on system resources may not be all that noticeable. If you're currently running WinNT 4 and you plan to buy new hardware to feed your gaming jones, be sure to first check the HCL for driver support.

If you're a Win95/98 user, you have many issues to consider before jumping ship. First, the upgrade could seriously break your computer if your hardware isn't properly supported, so verify all of your components beforehand. Second, be sure you have a specific reason to jump to 2000. Running dual processors is a very attractive proposition, but only if your favorite software is multithreaded and optimized to take advantage of two CPUs as often as possible. Also, if you're continually victimized by hard system crashes, you may want to jump to Win2000 for a more stable working environment.

However, if you're primarily a gamer who merely dabbles in application work, you should stick with Win98 for the short haul. However piecemeal its code may be, Win98 does offer better frame rates than Win2000. We suggest you wait three months or so for the first Win2000 service pack. By then, most of Win2000's performance bugs should be ironed out, and videocard manufacturers will have released better drivers.

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▶ Portable MP3 Players Put the Music in Your Pocket

Choosing a portable MP3 player is a little like eating Dim Sum—dozens of options are available, and not all of them look familiar. Of course, more options mean a better fit for you. Need a player that'll play tunes through your morning jog, or through your round-the-world backpacking trip? Whichever you choose, pick up your own set of headphones, because none of these players includes a worthy enough set.

FYI, we know Creative's Nomad and Diamond's RIO are the most popular players out right now, but new models weren't available at press time. We'll have full reviews soon.

—Kristen Shepos-Salvatore

Specs	i2Go eGo	iJam Player
Size/Weight	4.5-inch L x 2.75-inch W x 1.25-inch H/5 oz	3.38-inch L x 2-inch W x 0.88-inch H/2.5 oz
Price	$349 for 96MB version, $29 for extra CF-2 card	$199, $49 for additional MultiMedia cards
Sound quality	100dB signal-to-noise ratio	85dB signal-to-noise ratio
Storage	Uses removable Compact Flash II (CF-2) cards (includes 96MB card) and has no internal memory.	Uses removable SanDisk MultiMediaCards, which are available in 16MB only. No internal memory.
Connection type/Max transfer rate	USB/150K/sec	USB/104K/sec
Bitrate supported	Up to 320kbps. VBR files are not supported.	Up to 160kbps. VBR files are supported.
Audio formats supported/ Flash upgradeable?	Supports MP3 and ADPCM (for audio recoding)/ Can be upgraded to play SDMI-encoded files.	Supports ATRAC3 and MP3, as well as WMA by the time you read this/Upgradeable to future formats.
Bundled software	*MP3Agent* allows you to create playlists, upload files, and even record and listen to e-mails as MP3s. *MusicMatch Jukebox* is included for ripping CDs.	Includes *MusicMatch Jukebox* and software for the MultiMedia card reader. Loading MP3s is a simple matter of exporting an *MMJ* playlist to the card.
Special/additional features	Two AA batteries, DC adapter, and car adapter kit are included. eGo has an external speaker and mic.	Two AAA batteries, a USB card reader, and two 16MB cards are included. iJam has an FM tuner.
Our Two Cents	eGo does everything but feed your cat. Listen to MP3s with headphones or in the car; receive, record, and send audio e-mails; and use *MP3 Agent* to schedule unattended searches for songs, news, or anything that can be stored as an MP3 file. We were wowed by eGo's functionality—but a little less keen on its sound. Full-bodied tones sometimes gave way to distortion on low bass beats and overall fuzziness. Volume went sufficiently high, but delivered serious distortion after level 15 (out of 20). eGo's wide-ranging functionality definitely appealed to our id, but our ego says its inconsistent sound output could put it in the same category as your daddy's portable music player.	iJam's functions are relatively vanilla, though the FM tuner is a nice treat. Still, iJam is so tiny, light, and grippable, we wanted to hug it and love it and call it George. With the treble and bass settings adjusted to their highest levels, sound playback was among the best we listened to, with crisp highs and lows that suffered from almost no distortion. And iJam delivers volume that actually packed some punch. Sadly, the MultiMedia cards hold just 15 minutes of CD-quality music. At $50 a pop for extra cards, this player is just prohibitively expensive, which is a shame, because its tiny size and sharp sound output could have made it our choice for truly portable music.
Verdict	**7**	**6**
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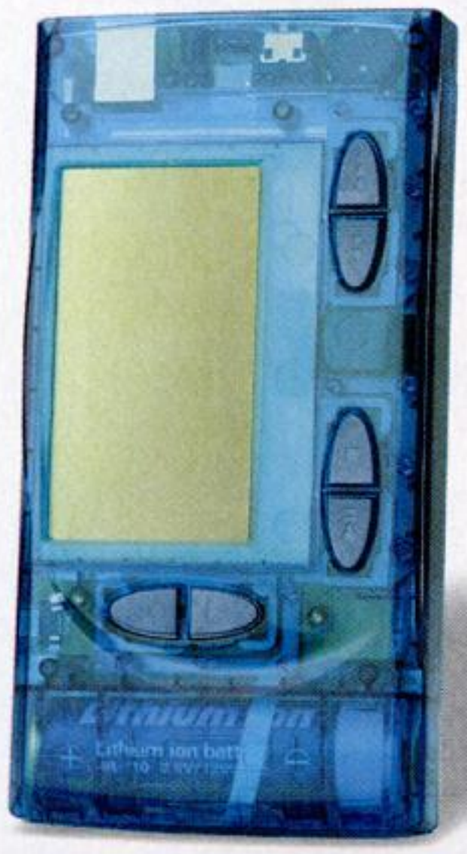

HanGo Personal Jukebox	Sony Music Clip	Pine D'Music
3.15-inch L x 5.9-inch W x 1.02-inch H/9.9 oz	4.69-inch L x 0.91-inch W x 0.88-inch H/1.69 oz	3.25-inch L x 2.5-inch W x 0.85-inch H/2.2oz without battery
$799	$299	$299
90dB signal-to-noise ratio	85dB signal-to-noise ratio	90dB signal-to-noise ratio
4.86 GB hard drive. No removable media is supported.	64MB built-in, but only 60.8MB is actually available for storage. No removable media is supported.	32MB onboard memory, and support for 32MB removable 3.3V SmartMedia.
USB/400K/sec	USB/500K/sec	18-pin parallel port/90K/sec
Up to 320kbps. VBR files are supported.	Up to 256kbps. VBR files are not supported.	Up to 256kbps. VBR files are supported.
MP3/Upgradeable to future formats via an option in the software's file menu.	ATRAC3 and MP3; slated to support WMA by the time you read this/Upgradeable to future formats.	MP3; also supports DigiCap copyright protection/Upgradeable to future formats.
Personal Jukebox Manager rips CDs and loads MP3s onto the player, but can't be used to play music. It also has problems with networked MP3s.	*OpenMG Jukebox* can import MP3s with Media Player 6.4 and/or Windows 98 SE, and rips SDMI-compliant files at 66kbps, 105kbps, or 192kbps.	*D'Music MP3 Manager* organizes MP3s into playlists and loads tunes onto the unit. *MusicMatch Jukebox* and *AudioCatalyst* shareware are included
A rechargeable Lithium ion battery and mini-to-twin RCA cable for stereo hookup are included.	Uses one AA battery, which is included.	Two AAA batteries. D'Music has a mic and one-touch voice recording capabilities.
At about the size of early Walkmans, the PJ is kinda chunky. We got past this when we loaded 300 songs onto it and saw that we'd barely touched its storage capacity. Plump can be pleasant! Sound output was the best, and certainly the loudest we heard, with virtually no distortion at even the highest volume. But the PJ is a delicate creature—you would be too, if you were a hard drive encased in a thin plastic shell. Perhaps instead of the vinyl carrying case, HanGo should have included a plastic bubble. No matter—it's too cumbersome for sporty types anyway. Still, we think the PJ is the best way to take your entire MP3 collection with you anywhere but on a jog, and it guarantees that you'll hear your tunes at top quality.	The Music Clip wins the good-looks award, and it's easy to use because it doesn't do much except play, stop, shuffle, and repeat. Overall sound quality is fair, but low bass beats lacked oomph and the volume just didn't go high enough. 120 minutes of music means 66kbps files—for 128kbps files, you get a measly 60 minutes. Memory expansion isn't an option—feh! Our biggest beef is with *OpenMG Jukebox*, which encrypts audio files so they can only be played back on that PC—no trading tunes with pals, and no filling the MC at another computer. Adding insult to injury, we could only disconnect the Music Clip after closing *OpenMG Jukebox*, otherwise our PC crashed like MPC editor Geoff Visgilio after sucking down a Slurpee.	When we saw its parallel connection, we were ready to toss D'Music in d'trash, but filling it with about 20 MP3 files was actually a speedy affair. D'Music's sound is admirable, with generally clear output and minimal distortion at even the highest volume (which got sufficiently loud). Equalizer settings appear to be legitimately optimized for the peculiarities of different music genres, and we liked being able to delete files directly from the player without connecting it to a PC. One irksome quirk is that D'Music shuts off after about 30 seconds if it's not playing files. That's a nice way to protect the batteries when you're toting it around, but it's a pain when you're attempting to transfer files between D'Music and the PC.
9	**5**	**8**
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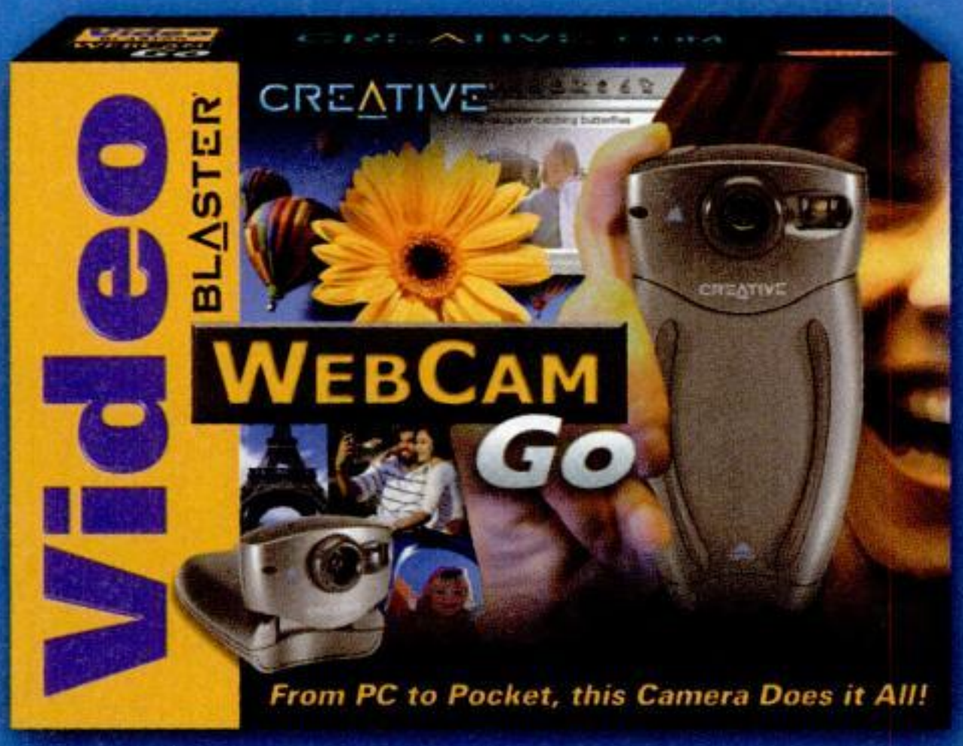

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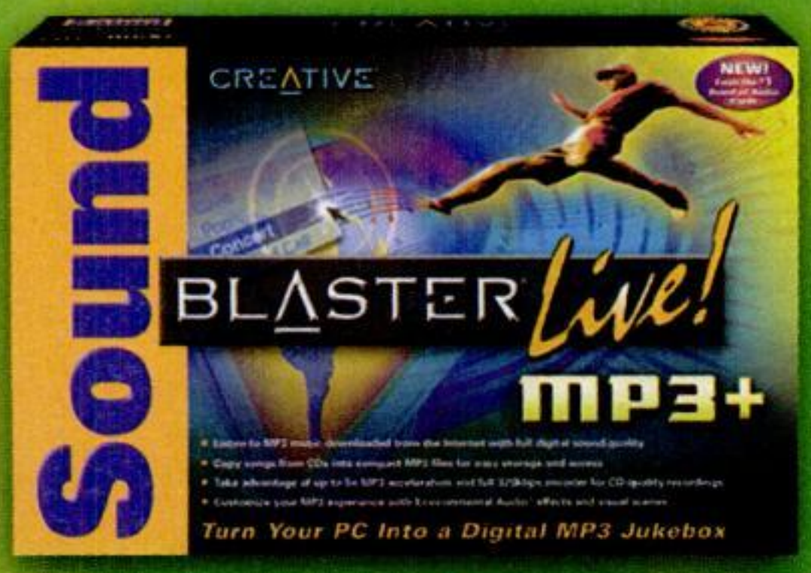

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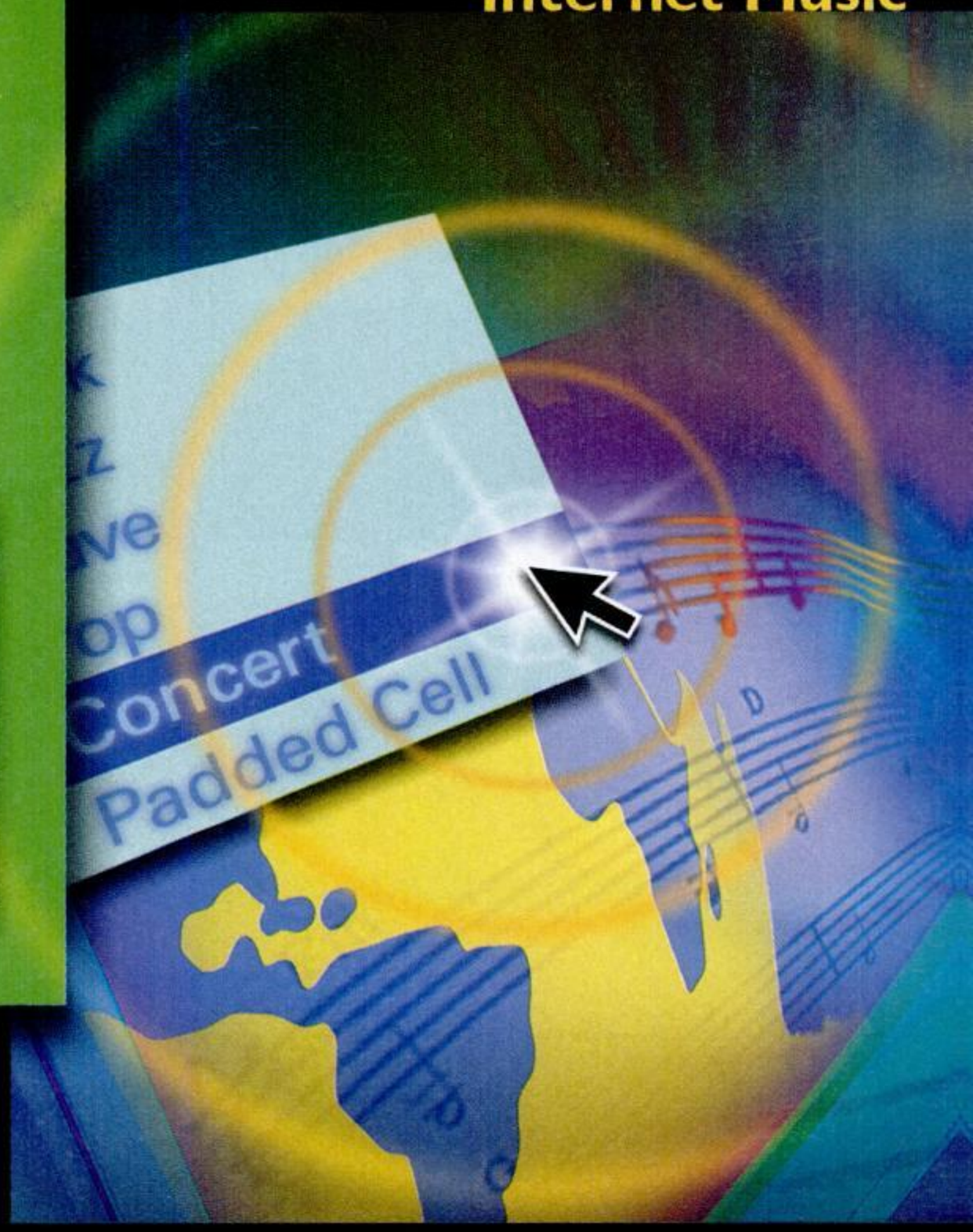
The Best Digital Clarity from a 3-piece Speaker System



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ENTERING the BIOSphere

How to Tweak Your PC's Most Basic Settings for Power and Reliability

BY LENNY BAILES

Beneath the mundane DOS command prompt and the ornate facade of Windows, there exists a middle ground between hardware and software. This combination of hard-coded computer blueprints and tweakable settings is called the Basic Input Output System (BIOS), and it sets the rules for how your operating system accesses your CPU, memory, disk drives, and peripheral slots. Onboard a Complementary Metal Oxide Semiconductor (CMOS) chip, the BIOS stores vital information about the computer's configuration. Whenever you change a disk drive in your computer, put a new card in a slot, or update the date and time, the updated BIOS configuration information is written to the CMOS chip and stored.

The entrance to this subterranean site is a special keystroke that must be pressed as the system boots. The key combination to enter the BIOS setup utility is usually displayed early in the boot process near the bottom of the startup screen. DEL, F2, and CTRL+ALT+S are the common ones. (If you can't spot the magic key, try hitting the Pause key to freeze the text display on the screen).

Experienced computer users know that BIOS settings can be fine-tuned like the engine of an automobile. Particular settings can control the timing of the CPU and memory chips, set speed limits for the hard disk and video cards, and govern the availability of system resources used by Windows. To many PC users, the internal workings of the BIOS are a mystery. Most OEM computer vendors treat the subject with Victorian delicacy (better you shouldn't ask!), and motherboard manuals contain short, cryptic descriptions (if any) written by technical engineers.

To get you the straight dope on what your BIOS settings mean and how they affect system performance, *Maximum PC* went straight to the source—the engineers who design BIOSes. We selected the Abit BX-6 motherboard with the Intel 440BX chipset and Award BIOS, a popular choice among system builders, and grilled the Award engineers to find out what the complicated labyrinth of BIOS settings means to you. Can adjusting BIOS settings make your PC faster or safeguard against system crashes? What do you do when Windows stubbornly refuses to recognize a new piece of hardware?

Keep in mind that your computer may not display all of the BIOS settings discussed here. Generally, computers sold by large OEMs have the advanced BIOS options hidden or removed—the theory being that users are better off when the computer's defaults can't be easily altered.

Caution should be exercised when tinkering with the settings that are available in your computer's BIOS. Write down all of your current BIOS settings before you change anything. The days when one arbitrary tweak would make your computer go dead are mostly gone, but tinkering can still make your hardware throw fits. Fortunately, most BIOSes include an option that will automatically restore manufacturer defaults.

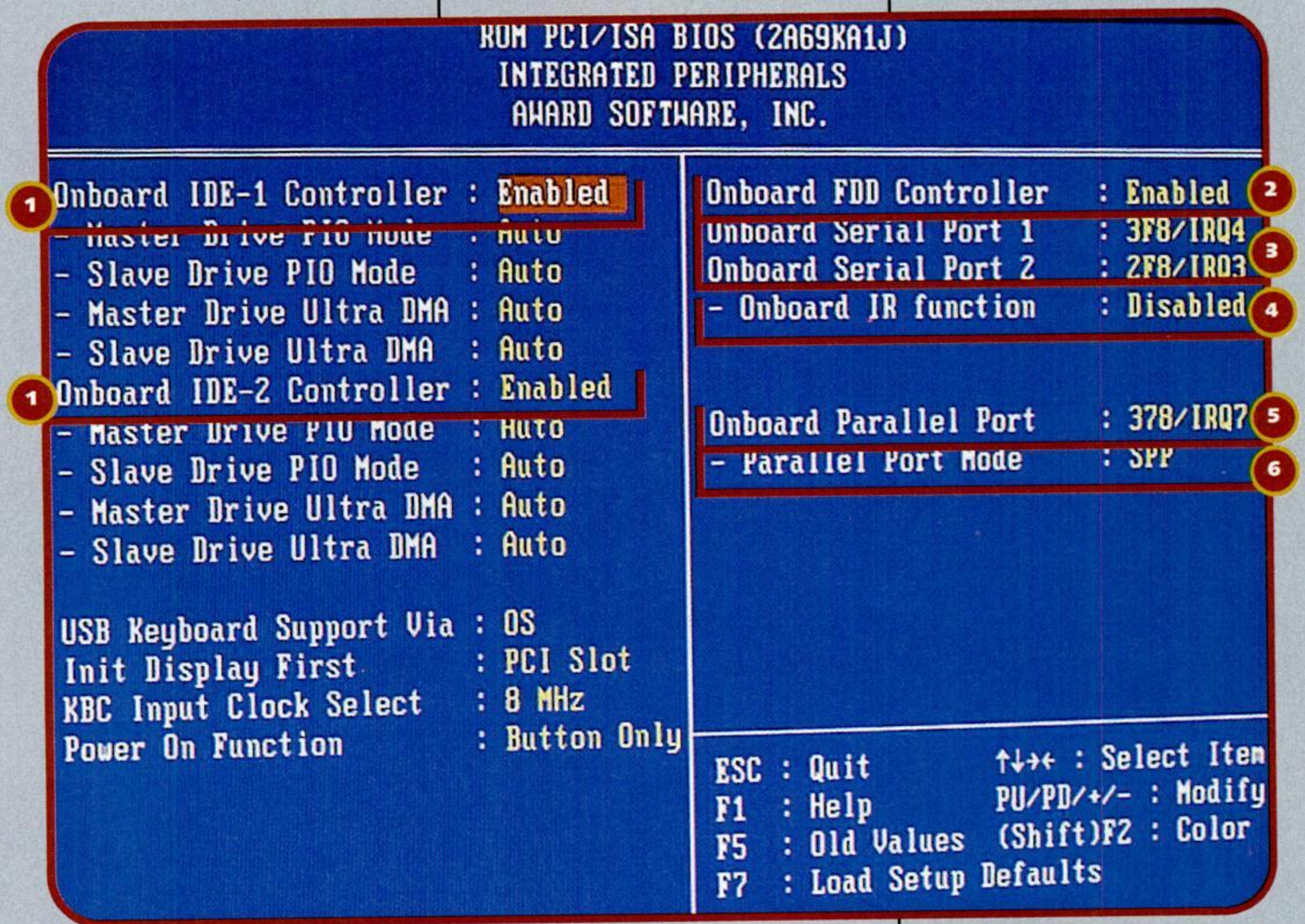
In the unlikely event that you change something and make the BIOS inaccessible, some computers allow you to restore the system defaults by holding down the Insert key as you flip the power switch. Other computers have physical hardware jumpers mounted on the motherboard that you can "short" to wipe out the CMOS chip. But on some computers, setting and forgetting a password is irreversible—which means that you need to send the motherboard to the manufacturer to have it reset. So be careful.

Bearing these things in mind, what we learned in our preparation for this feature can be boiled down to this: A default BIOS option is not necessarily the best option for people who want *optimal* performance, but it is generally the best option for people who want *reliable* performance.

1 ONBOARD IDE CONTROLLER: These settings allow you to disable one IDE controller (or both), which is handy if you're short on system resources. For instance, if you configure the CD-ROM to be a slave drive on IDE Controller-1, you can disable IDE Controller-2, freeing up IRQ 15 for use by another device. Or, if your computer has a SCSI hard drive and CD-ROM with no IDE devices, you can disable both IDE controllers, freeing up IRQs 14 *and* 15.

2 ONBOARD FDD CONTROLLER: This toggles recognition of the floppy drive controller on and off for the DOS operating system. You would think that setting this option to "Disabled" would stop the floppy disk icon from appearing under Windows 95/98, but it usually doesn't. Newer motherboards have a special setting to accomplish this on the BIOS Features menu.

3 ONBOARD SERIAL PORT: By default, these enable recognition of the two onboard serial ports for use with a mouse, external modem, or other peripheral. A setting of "Auto" usually defaults to IRQ 4 and port address 3F8 for COM1 and IRQ 3 with port address 2f8 for COM2. If you aren't using your serial ports, you can set these options to "Disabled" and free up a couple of IRQs for use with other peripherals.


ROM PCI/ISA BIOS (2A69KA1J)
INTEGRATED PERIPHERALS
AWARD SOFTWARE, INC.
1 Onboard IDE-1 Controller : Enabled
- Master Drive PIO Mode : Auto
- Slave Drive PIO Mode : Auto
- Master Drive Ultra DMA : Auto
- Slave Drive Ultra DMA : Auto
1 Onboard IDE-2 Controller : Enabled
- Master Drive PIO Mode : Auto
- Slave Drive PIO Mode : Auto
- Master Drive Ultra DMA : Auto
- Slave Drive Ultra DMA : Auto
USB Keyboard Support Via : OS
Init Display First : PCI Slot
KBC Input Clock Select : 8 MHz
Power On Function : Button Only
Onboard FDD Controller : Enabled 2
Onboard Serial Port 1 : 3F8/IRQ4 3
Onboard Serial Port 2 : 2F8/IRQ3
- Onboard IR function : Disabled 4
Onboard Parallel Port : 378/IRQ7 5
- Parallel Port Mode : SPP 6
ESC : Quit
F1 : Help
F5 : Old Values
F7 : Load Setup Defaults
↑↓→← : Select Item
PU/PD/+/- : Modify
(Shift)F2 : Color

4 ONBOARD IR FUNCTION: On mobos with infrared hardware support, the serial address can be switched from the standard setting to an IR port that's used to send and receive data from a digital camera or PDA. Some mobos also include a setting that toggles between "half" and "full" duplex IR transmissions. For bidirectional transfers with a PDA, set this to full duplex.

5 ONBOARD PARALLEL PORT: If you don't have a printer, portable drive, or other device attached to the parallel port, disable this option to free up an IRQ for use by another peripheral. If a device attached to the parallel port is having trouble under Windows, switch the default parallel resources from IRQ7/378 to an alternate interrupt/address configuration.

6 PARALLEL PORT MODE: Newer printers are faster when the Parallel Port is set to Enhanced Com Port (ECP) or Enhanced Parallel Port (EPP) mode. If your printer manual doesn't tell you which mode to use, try toggling between modes. Keep in mind that ECP mode uses a DMA channel to achieve 2.5Mb/sec bidirectional transfers.

INTEGRATED PERIPHERALS MENU

The Integrated Peripherals screen holds most of the settings that affect disk drives, videocards, serial, parallel, and USB ports. Individual settings allow you to enable or disable motherboard devices; adjust the data transfer mode for your hard drive; and modify or disable the computer's parallel and serial port. For each active peripheral controller or I/O port, Windows generally requires a dedicated port address and hardware interrupt request line (IRQ). Since PCs are equipped with only 15 IRQs, and several of them (IRQs 2, 6, and 14) are generally reserved, there is a definite advantage to understanding the settings on this screen. If your computer is "loaded" with a network card, soundcard, DVD decoder, modem, and SCSI controller, you can bet your last donut that you'll run out of IRQs and one or more of these devices will fail to work under Windows. If you're not using a motherboard device, such as an IDE controller or serial port, it can be disabled, allowing you to free an IRQ for another device.

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1 Virus Warning: Enabling this setting installs a watchdog that intercepts and alerts you when anything tries to overwrite the boot sector or partition table. This provides quick-and-dirty protection against boot sector viruses but can cause problems when you try to upgrade your OS or run any disk maintenance software such as *Norton Utilities*. This is *not* a substitute for full-featured antivirus software.

2 Quick Power On Self-Test: You can disable this option to make the computer skip some of its internal diagnostic tests at startup. This speeds up the boot process. The drawback is that you lose your early warning system if memory chips or other components are about to fail.

3 IDE HDD Block Mode: When enabled, this setting (sometimes called 32-BIT I/O) speeds up IDE drives by allowing multiple sector read/write operations. Most IDE drives manufactured in the last several years support Block Mode under Windows 95 and 98. However, under Windows NT Workstation or Server, Microsoft recommends that you disable this setting to avoid data corruption.

```
                ROM PCI/ISA BIOS (2A69KA1J)
                BIOS FEATURES SETUP
                AWARD SOFTWARE, INC.

1 Virus Warning                 : Disabled
  CPU Level 1 Cache             : Enabled
  CPU Level 2 Cache             : Enabled
  CPU L2 Cache ECC Checking     : Enabled
2 Quick Power On Self Test      : Enabled
  Boot Sequence                 : A,C,SCSI
  Swap Floppy Drive             : Disabled
  Boot Up Floppy Seek           : Disabled
  Boot Up NumLock Status        : On
3 IDE HDD Block Mode            : Enabled
  Typematic Rate Setting        : Enabled
  Typematic Rate (Chars/Sec)    : 30
  Typematic Delay (Msec)        : 250
4 Security Option               : Setup
  PCI/VGA Palette Snoop         : Disabled
  OS Select For DRAM > 64MB     : Non-OS2
5 Report No FDD For WIN 95      : No
  Delay IDE Initial (Sec)       : 0
  Processor Number Feature      : Disabled

  Video BIOS Shadow             : Enabled   6
  C8000-CBFFF Shadow            : Disabled
  CC000-CFFFF Shadow            : Disabled
  D0000-D3FFF Shadow            : Disabled
  D4000-D7FFF Shadow            : Disabled
  D8000-DBFFF Shadow            : Disabled
  DC000-DFFFF Shadow            : Disabled

ESC : Quit          ↑↓→← : Select Item
F1  : Help          PU/PD/+/- : Modify
F5  : Old Values    (Shift)F2 : Color
F7  : Load Setup Defaults
```

4 Security Option: This works in conjunction with the password Option (which, on this motherboard, is located on the Main BIOS screen). If you've created a Password, setting this option to "System" will make the computer ask for a password each time the system boots up, before the OS is permitted to load. If you change the option to "Setup," the computer will only prompt for a password when someone attempts to reconfigure the BIOS.

5 Report No FDD for Windows 95: Setting this option to "Yes" convinces Windows 95 and 98 that your computer has no floppy disk controller, freeing up IRQ 6 for use by other peripherals. If you're running without a floppy drive (on a notebook computer, for instance), you should set this to "Yes" and toggle the OnBoard Floppy Controller on the Integrated Peripherals menu to "No."

6 Video BIOS Shadow: When enabled, this legacy feature copies the code in the video section of your system's BIOS from ROM into RAM. Under DOS, this used to speed up the screen display for games, but it has no effect in Windows, since DirectX and OpenGL games bypass the system BIOS and write directly to the videocard. Enabling this option could decrease your PC's stability, since ill-behaved games may overwrite video instructions cached in RAM.

BIOS Features Menu

The BIOS Features menu is full of configuration options intended to let an advanced user customize PC performance. For instance, you can toggle off the Boot-up Floppy Seek and Quick Power-On Self Test in order to shorten your boot time. In the BIOS Features menu, you can step up your IDE hard disk performance by enabling HDD Block Mode, and customize keyboard response with the three Typematic Rate settings. Other options let you enable a simple form of virus protection on your hard disk and specify the access limits of a security password.

A few leftover relics from 386 days still linger in the Features menu. Video and System BIOS Shadow options made sense under Windows 3.1 and the real-mode DOS operating system, where they significantly speed up memory-to-CPU action and video performance. But contemporary hardware under Windows just bypasses the code stored in these locations. If you change your mind about a particular modification, you can press the F5 key to revert to the previous value or press F7 to restore all of the factory defaults.

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1 SDRAM-RAS-TO-CAS DELAY: This setting tweaks the delay between two signals transmitted to the mobo's system memory: the Row Address Strobe and the Column Address Strobe. The number indicates how many clock cycles the memory needs in order to prepare for another transaction. Reducing this setting from 3 to 2 might speed up memory performance, but if you experience stability problems, change it back.

2 SYSTEM BIOS, VIDEO BIOS, VIDEO RAM CACHEABLE: Caching System BIOS, Video BIOS, and Video RAM in L2 would make your PC run faster if Windows actually used them after the initial boot sequence. But it seldom (if ever) needs to do this. Considering how precious L2 cache space is, you'll do better letting Windows use it for other tasks. We recommend that you leave these settings disabled.

3 PASSIVE RELEASE: If Passive Release is enabled, the CPU can read from and write to the PCI bus concurrently with data transfers along the ISA bus. When disabled, the CPU must access the bus through a PCI bus master during ISA activity. In general, enabling this option will speed up performance. It should only be disabled if you are experiencing problems with your ISA cards.

```
                ROM PCI/ISA BIOS (2A69KA1J)
              CHIPSET FEATURES SETUP
               AWARD SOFTWARE, INC.

1 SDRAM RAS-to-CAS Delay    : 3          Temperature Warning
  SDRAM RAS Precharge Time  : 3          System (RT1) Temperature
  SDRAM CAS latency Time    : Auto       CPU (RT2) Temperature
  SDRAM Precharge Control   : Disabled   Chassis Fan (FAN2) Speed
  DRAM Data Integrity Mode  : Non-ECC    Power Fan (FAN3) Speed
  System BIOS Cacheable     : Disabled   CPU Fan (FAN1) Speed
  Video  BIOS Cacheable     : Enabled    VCORE :  2.01 V      VTT
2 Video RAM Cacheable       : Disabled     VIO :  3.32 V      +5V
  8 Bit I/O Recovery Time   : 1          +12V : 11.85 V      -12V
  16 Bit I/O Recovery Time  : 1           -5V :- 5.04 V      5VSB
  Memory Hole At 15M-16M    : Disabled
3 Passive Release           : Enabled
4 Delayed Transaction       : Disabled
5 AGP Aperture Size (MB)    : 64
6 Spread Spectrum Modulated : Disabled
```

4 DELAYED TRANSACTION: When the CPU is accessing the ISA bus, PCI cycles take a longer time to complete, even with the Passive Release BIOS setting enabled. To further compensate for this bottleneck, you can enable Delayed Transactions. This creates a write-buffer in the motherboard's chipset that can synchronize ISA and PCI transactions, allowing the ISA bus to send data to the CPU while the PCI bus is active.

5 AGP APERTURE SIZE: The AGP aperture is a reserved portion of the PCI memory address space used to store 3D-vertex and texture-map data. It corresponds to the actual amount of system RAM (from 4 to 256MB) that can be allocated to AGP. Some web sites claim that increasing the AGP aperture size improves 3D performance, but Award engineers say this isn't so. A setting of 64MB should be optimal unless the videocard manual recommends more.

6 SPREAD SPECTRUM MODULATED: Enabling this setting activates a Smart Clock feature that turns off AGP, PCI, and SDRAM signals when these components are not in use, thereby reducing the potential for electro-magnetic interference (EMI). Award cautions that enabling this setting can decrease system stability, so you should leave it disabled unless your computer is experiencing heavy electromagnetic interference.

CHIPSET FEATURES MENU

The settings in the Chipset Features menu relate to timing issues for read and write operations to memory and the system bus. In the early days of 386 and 486 motherboards, you could sometimes gain significant performance increases by tweaking these settings, until you reached the point where the system crashed all the time or just wouldn't boot. On modern motherboards, there's much less to be gained by manipulating SDRAM-to-CAS Delay, SDRAM RAS Precharge Time, or SDRAM CAS Latency Time. And System BIOS and Video BIOS sound like good ideas until you realize that today's protected-mode OSes rarely access this code after bootup.

On the other hand, there are a few unnoticed ISA-to-PCI settings that can be tweaked to improve overall system performance. By default, the motherboard will often slow down or suspend PCI bus operations when an ISA peripheral is accessed. Settings such as 16-bit I/O Recovery Time, Passive Release, and Delayed Transaction, can be tweaked to redefine the relationship between the PCI and ISA data buses, so that your PCI cards are never forced to wait for some stanky-ass old ISA card.

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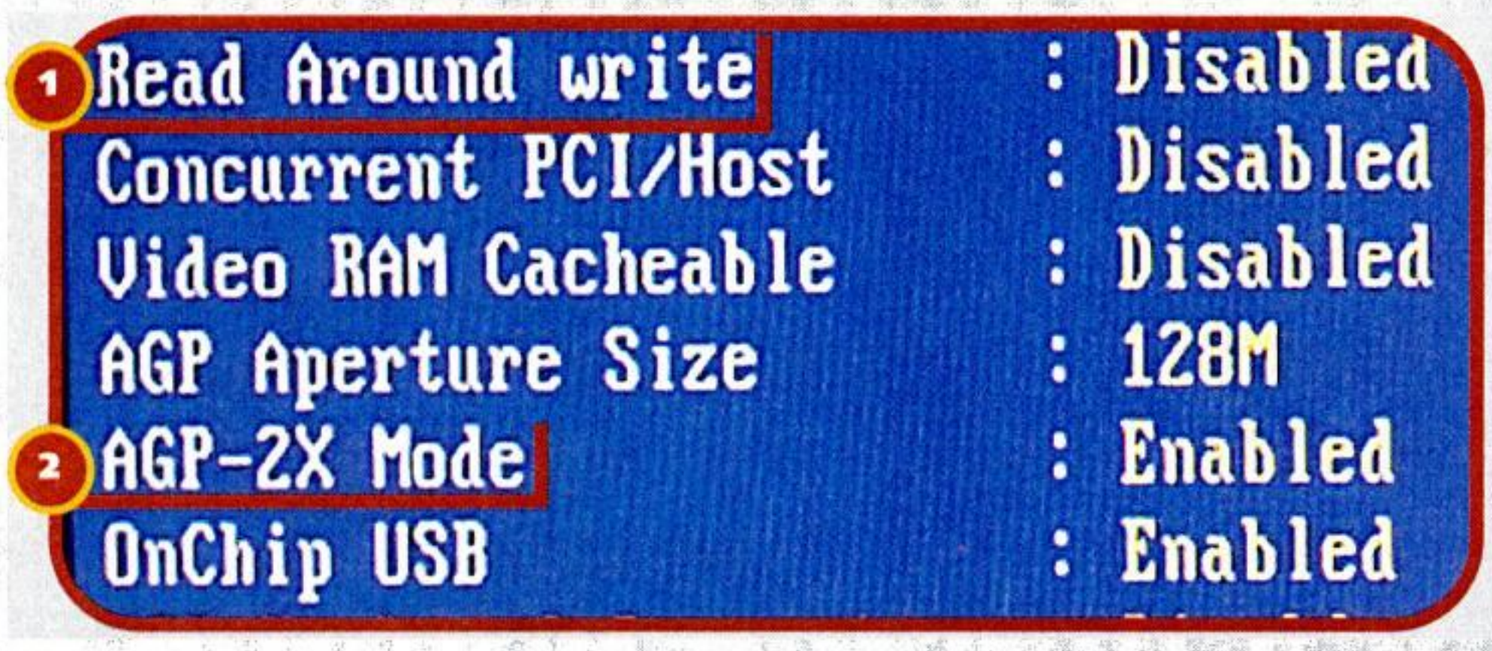

1 Read Around write : Disabled
Concurrent PCI/Host : Disabled
Video RAM Cacheable : Disabled
AGP Aperture Size : 128M
2 AGP-2X Mode : Enabled
OnChip USB : Enabled

Other Settings

Init Display First: Your PCI videocard is generally initialized as the primary video controller on your PC, but if you're running multiple monitors and want your AGP card to be the boss, you can use this BIOS setting to make it so. To use the AGP controller for the primary monitor and the PCI Card for an auxiliary monitor, change this setting to "AGP." With the option set to "PCI Slot," the PC will recognize the PCI card as the primary video controller.

Processor Number Feature: This feature is only active when your computer has a Pentium III processor installed. Intel caused a small uproar last year, when it designed the Pentium III to automatically report its serial number to Windows 98 for monitoring by external applications. The default setting of "Disabled" suppresses this feature, to protect your privacy.

(1) **Read Around Write:** (second chipset screen) This feature, found in some Award BIOSes, can slightly speed up system performance by allowing the CPU to execute read commands on the contents of an address directly from the L2 cache before its latest contents are actually transferred to system memory. According to Award, the performance increase is only .0001 percent, but some hardware gurus recommend enabling it anyway, since the impact on stability is minimal.

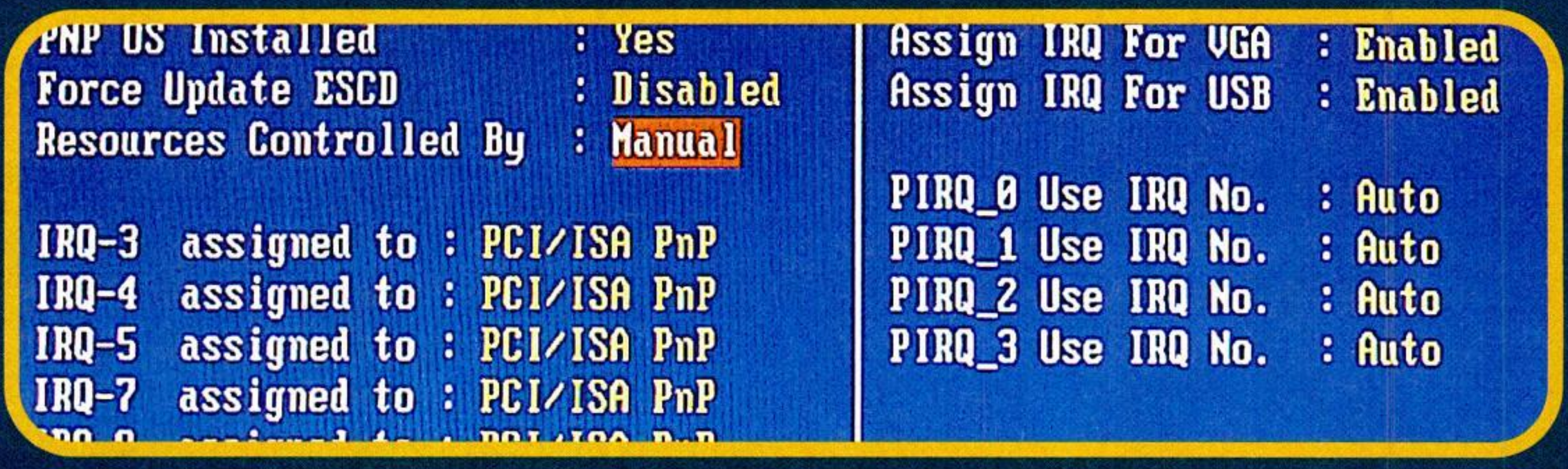
(2) **AGP 2x Mode:** There are several generations of AGP graphics adapters in circulation right now with 1x, 2x, and 4x speed configurations. Some motherboards detect the AGP card and automatically assign it the highest speed supported by the internal chipset. Others include this option in the BIOS, which allows you to speed up or slow down the default setting (the most recent motherboards offer a corresponding AGP 4x option). If your videocard supports AGP 2x or AGP 4x data transfers, be sure this BIOS setting is configured appropriately to get the most out of your card. However, if you're experiencing compatibility problems—applications or games crashing—try bumping the setting down to stabilize the system.

TURNING PLUG-AND-PRAY INTO PLUG-AND-PLAY

Intel developed its PCI Plug-and-Play motherboard standard before Microsoft integrated Plug-and-Play support into Windows 95. Each standard provides a way for your PC to dynamically assign resources—you can choose between your BIOS ("the devil") or Windows ("the deep blue sea"). The toggle switch is in your BIOS; it's a simple yes/no setting in the PNP/PCI Configuration menu called Plug-and-Play OS. Set to "Yes," the Plug-and-Play OS setting puts the BIOS configuration options to sleep, handing Windows the task of dynamically assigning IRQs, DMAs, and port addresses to the peripherals installed on the PCI and ISA buses. Sometimes, this works out well. Other times, Windows can prompt you to put your fist through your monitor screen when the Device Manager refuses to let you change COM2 to COM1, IRQ 5 to IRQ 7, or port address 3BC to 378, taunting you with an immutable "This Resource Cannot be Modified" message.

Your motherboard may be smarter than Windows 98. If you want to find out, you can set the Plug-and-Play OS setting to "No," reboot the computer, and see what happens. The system hardware will give the orders as to which slot gets which IRQ, and Windows will dutifully accept them. But you may still run into problems. With the BIOS dictating your resource assignments, Windows can't dynamically re-assign them. Say your network card draws IRQ 10, but it needs IRQ 5. Since the BIOS has already assigned the card IRQ 10, there's no IRQ left over for the USB controller, and it still has a big exclamation point next to it in the Device Manager list.Your third alternative is to toggle the "Resources Controlled by" option on this menu from Auto to Manual. A list of all the IRQs on the computer will appear, allowing you to assign each one to either the PCI/ISA Plug-and-Play bus or to the legacy ISA bus.

Check it out Online
www.maximumpc.com
For even *more* BIOS tweaks, go to the re:print section of our website; we couldn't fit them all here.


PNP OS Installed : Yes
Force Update ESCD : Disabled
Resources Controlled By : Manual
IRQ-3 assigned to : PCI/ISA PnP
IRQ-4 assigned to : PCI/ISA PnP
IRQ-5 assigned to : PCI/ISA PnP
IRQ-7 assigned to : PCI/ISA PnP
Assign IRQ For VGA : Enabled
Assign IRQ For USB : Enabled
PIRQ_0 Use IRQ No. : Auto
PIRQ_1 Use IRQ No. : Auto
PIRQ_2 Use IRQ No. : Auto
PIRQ_3 Use IRQ No. : Auto

If you don't want to leave your precious hardware resources in the clutches of Windows, you can go old-school by manually assigning resources.

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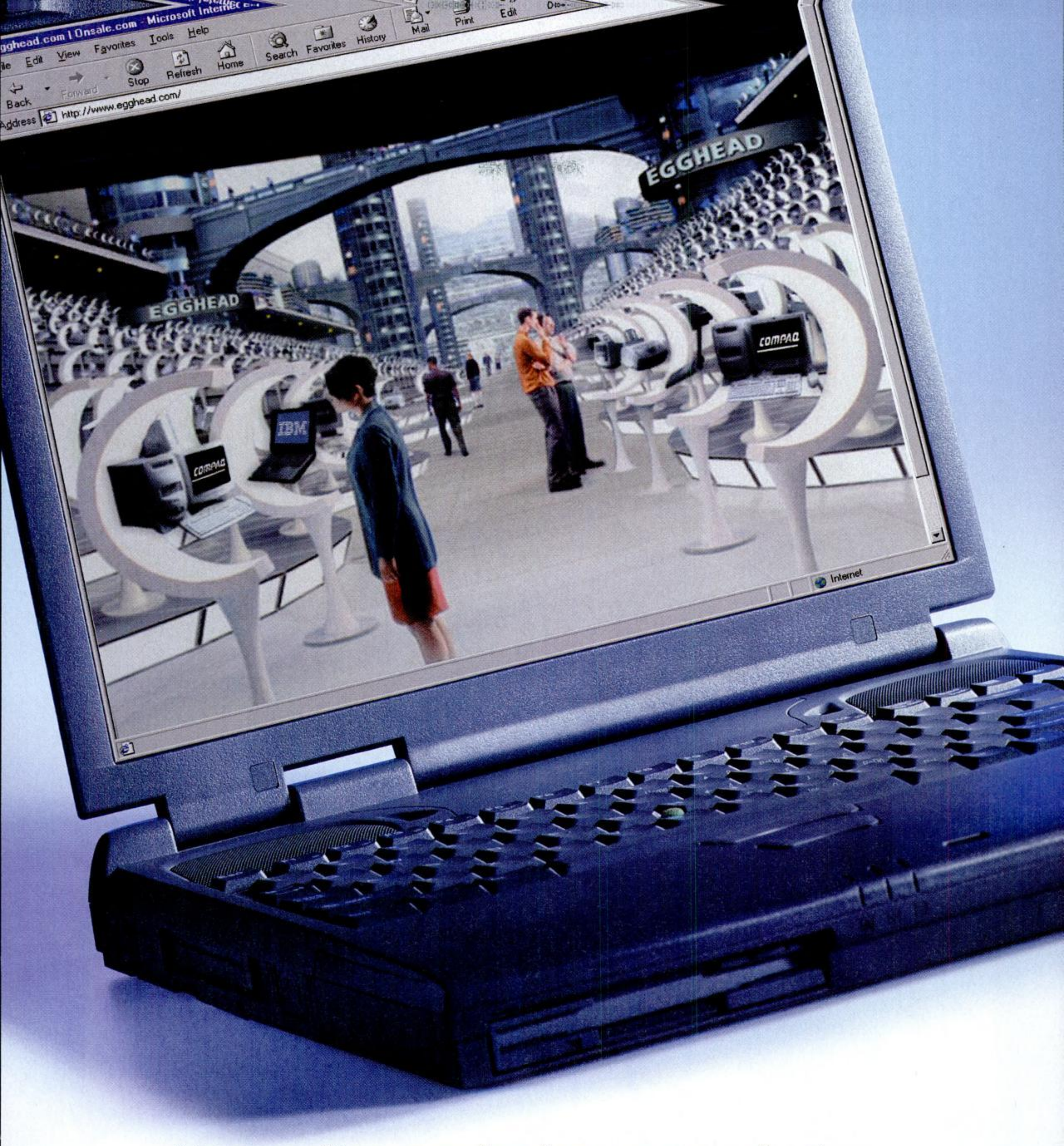

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So what if you've got a 1GHz CPU, two months' pay worth of RAM, and the latest bad-ass videocard? The only thing people ever see is your case.

If your gear is still riding in a dented-up hooptie, it's time to move up, baby. You say you don't care about aesthetics? Well, what about performance? Your case informs almost every tweaking decision you'll ever make, from the number of storage drives you can install to how you'll cool down your overheating parts.

We searched the exotic land of PC arcana for six cases worthy of carrying your precious PC components. But before you read our reviews, dig the case features we consider most important:

▶ **Size** Full- and mid-tower cases contain lots of space for expansion, and give you easy access to the parts within.

▶ **Drive bays** You don't think you'll ever need six full-size drives bays? Then check out this list: CD-ROM, DVD-ROM, CD-R, DVD-RAM, and two external removable hard drives.

▶ **Rails** OK, we've overdosed on full-size drives, and now we need quick access to them. Installation rails can make life infinitely easier during upgrading.

▶ **Beefy power supply** If you think your 235W power supply is "good enough," read our primer on power. We want a minimum power supply of 300W, and prefer supplies from reputable manufacturers.

THE **MAXIMUM PC** COUNCIL ON POWER, EXPANSION & COOLING PRESENTS....

in search of the Perfect case

▶ **Structural integrity** We don't dig cases that bend in a heavy wind—or under the collective weight of the *Maximum PC* Wrestling Squad.

▶ **Airflow** A good case will be designed to keep air moving and parts cool; plenty of fan bays are imperative.

▶ **Removable motherboard tray** Full-towers with wide-open access don't need this option, but no mid-tower case should be without a removable tray. We prefer trays that slide out without requiring us to first remove add-in cards.

▶ **We've never seen these items**, but we're going to list them, just in case any chassis designer is listening: a single quick

By gordon mah ung

PHOTO BY MARK MADEO

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cases

disconnect for the power, reset, and speaker leads; a power supply that slips out without requiring us to first remove all the drives; and a front-mounted bezel for USB, FireWire, and audio connectors (similar to Creative Labs' multimedia drive bay).

For full details on all the cases appearing on the next few pages, consult the chart on page 62 and check out the manufacturers' web sites. And before you buy any case, dig the following information on cooling and power requirements.

Parts Access and Cooling

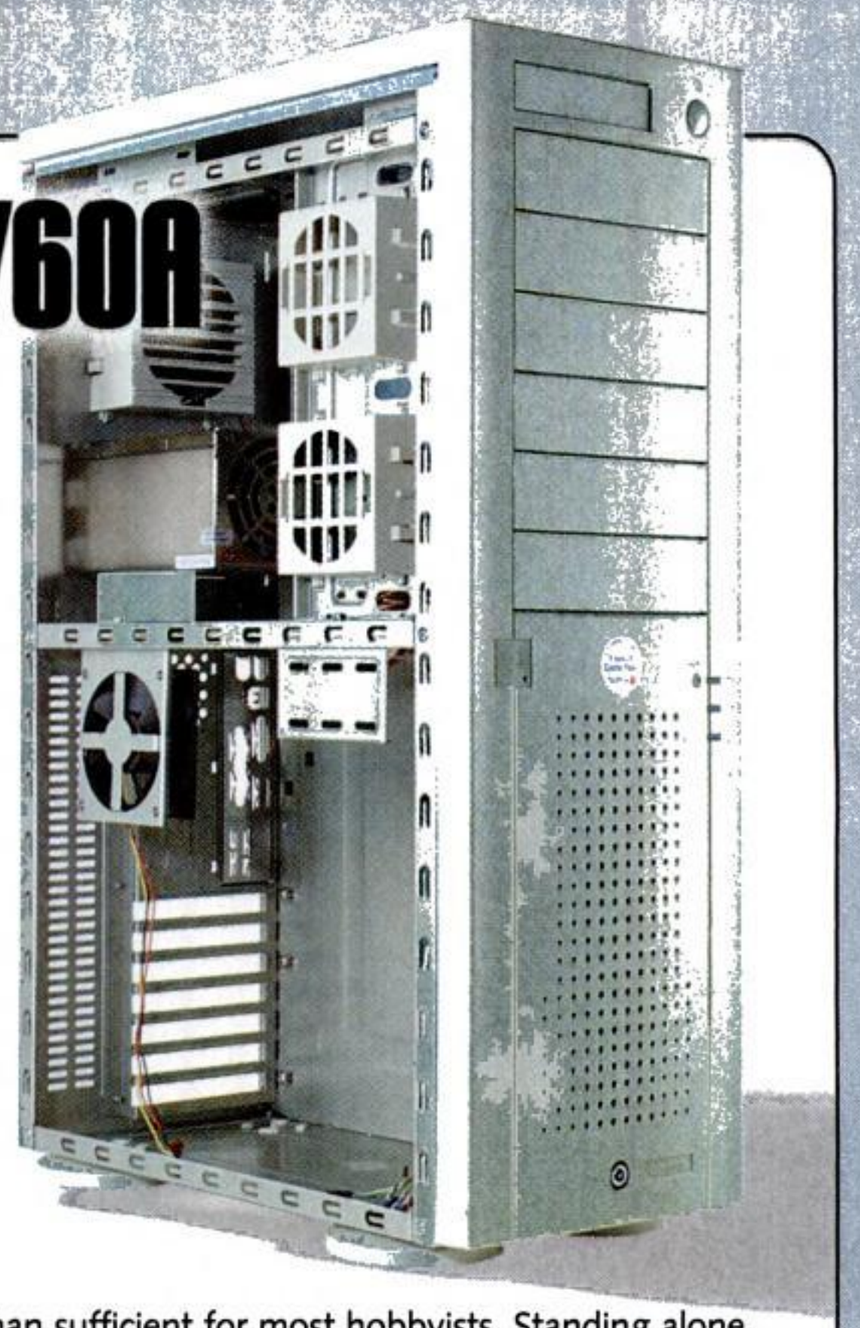
Any PC mechanic who's ripped open his knuckles swapping out a hard drive will tell you that a full-tower case's wide-open chest cavity is well worth the money. Full-towers also help you keep parts away from one another. This makes it painless to install that new DVD-ROM drive, where in a smaller case, the drive would have bumped up against your RAM.

With their expansive interiors, full-towers are also generally more conducive to critical airflow. They let you stagger hot-running drives in every other drive bay, and generally foster better air circulation. If you're starting from scratch, it doesn't hurt to buy the largest case possible in order to be prepared for any upgrading or cooling dilemma.

With all that stated, we know you'll still reach for that mid-tower case at the computer store. After all, who wants to raise his desk height just to accommodate his PC? If you're intent on a mid-tower, be sure it features at least two places to mount auxiliary fans; mid-tower cases tend to trap more hot air than their taller bruddas. Also be sure you can reach the CPU without having to pull out the power supply.

If you've ever felt the hot air rising off an 800MHz Athlon, you know the

SuperMicro SC-760A



PLUSES
- 9 fan mounts
- Lots of drive bays
- Auxiliary fan

MINUSES
- Relatively flimsy
- No redundant power supply

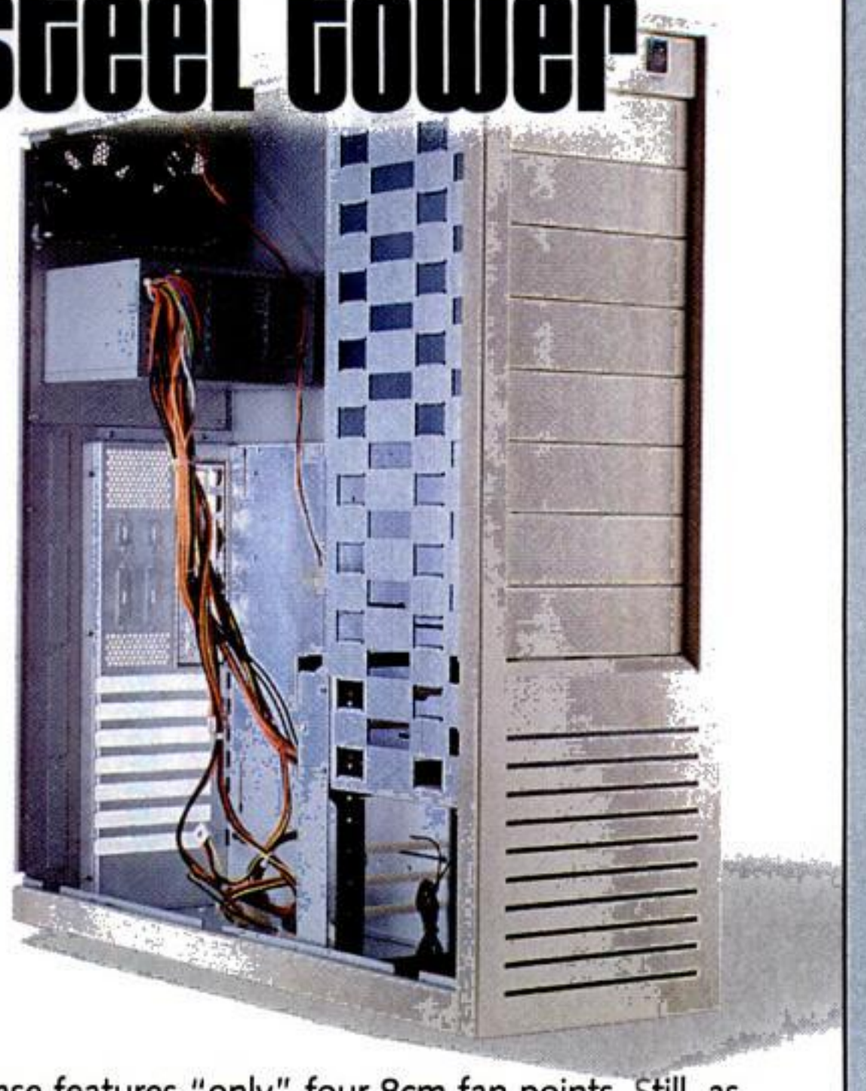
Essentially a polished version of the Addtronics 7890 that we used in Dream Machine 98, this SuperMicro case sacrifices a removable mobo tray and redundant power supply for a better paint job and slightly more rigid construction. Towering above all other cases in this roundup, the SC-760A features the second-largest amount of external drive bays, and trounced the other competitors in fan options. With no fewer than nine fan-mounting points (including four alongside the drive bays and one above the CPU), you'll have to lash down the SC-760A to prevent it from taking off.

Unique to SuperMicro is its 300W AbleCom power supply with a redundant fan. If the power supply detects that one fan has died, an auxiliary fan fires up and an alarm triggers. Considering the high failure rate of dust-clogged fans, this is a great idea.

Of the super-tower cases reviewed this month, we found the SC-760A to be slightly more flimsy than the two other contenders. Nonetheless, it's the least expensive of the super-towers and more than sufficient for most hobbyists. Standing alone, the SC-760A would have garnered much praise, but against stiff competition, it's a silver-medal winner. **$170, www.supermicro.com**

1 2 3 4 5 6 7 8 **9** 10

PC Power Solid Steel Tower



MAXIMUM PC KICK ASS! product

PLUSES
- Stronger than an ox
- 8 drive bays
- Power-user power supply options

MINUSES
- No natural 3.5-inch bays

This bad mother is sturdier than an engine block. We tested its strength by balancing *Maximum PC* editors on it, and while every metal case here could handle lightweight Kristen Salvatore, the Solid-Steel was the only case that could handle full-ass presses from our heftiest lab monkeys.

The Solid-Steel doesn't actually come with a stock power supply; you have to order your own, so we chose PC Power & Cooling's new $200 Turbo Cool 425. The company feels that you get what you pay for, and considers all those "free" power supplies to be sub-standard. After going online and checking the specs of the 425 watter, we can see why the company is so arrogant about its power. And of all the towers here, the Solid-Steel is the only one capable of running a 600W or 850W redundant power supply. The Solid-Steel features eight drive bays (the most in this roundup), but there's no provision for mounting 3.5-inch drives without using a bracket. Also, the case features "only" four 8cm fan points. Still, as Harley owners already know, you must live with the quirks to appreciate the pride in your ride. **$250** (without power), **www.pcpowerandcooling.com**

1 2 3 4 5 6 7 8 **9** 10

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ASL FULL TOWER

MAXIMUM PC KICK-ASS! product

PLUSES
- Incredible cooling engineering
- Hinged front bezel
- Solid construction

MINUSES
- Scant drive bays
- Funny fan connectors

The ASL has monster 12cm fans mounted in the front and rear of the case, along with a cage for mounting six 3.5-inch hard drives next to the 300W Antec power supply. You can run the drives in RAID or individually, but you know they'll run cool because the ASL features a 9cm fan mounted directly behind the cage.

The front-hinged bezel swings open for front-case access. For those who need hard drive lights, the ASL has six separately wired LEDs that can be hooked to various drives. We would have preferred two more full-size drive bays (the case comes with just four) but that's the sacrifice for small size. Also, be aware that the huge 12cm fans are powered off three-pin connectors, instead of the four-pin drive connectors we're so used to. If your mobo doesn't have enough fan power connectors, or if the connectors are in the wrong positions, you may have problems.

We found the ASL's construction to be a notch above the SuperMicro, but far short of PC Power's solid-steel design. If you need more drive bays, look elsewhere, but if you want ventilation, this baby is hard to beat. **$200, www.aslabs.com**

1 2 3 4 5 6 7 8 **9** 10

INWIN IW-S500-ATX

PLUSES
- Good CPU access
- Affordable

MINUSES
- No pop-out mobo tray
- Blah overall

Almost every long-time hobbyist has built a system using one of Inwin's popular cases. Sadly, Inwin's latest mid-tower, the S500, takes a critical step backward. The S500 features the same boxy looks of the A500 along with the standard drive allotment (three full, two mini) of most mid-towers, but no longer includes a removable mobo tray. In a full-size tower, a pop-out mobo tray doesn't serve much function because of the case's intrinsic easy access. But in a mid-tower, a pop-out tray is almost a must-have.

The S500 features an internal gondola that holds two hard drives. Power supply placement has been improved, giving you full access to the CPU without having to remove any parts (the A500 had a support bracket that made CPU gymnastics difficult). But true to the company's history, you'll still find a few sharp edges inside. Watch your knuckles! Like every case in this roundup, the A500 offers a rail system for mounting drives. Love 'em or leave them, rails do eliminate the need to open the right panel to access devices.

The S500 will accommodate a mini or micro ATX with no problems, but moving up to a full-size ATX motherboard will cost you one of the drive bays. **$60, www.astradata.com**

1 2 3 4 5 6 **7** 8 9 10

importance of cooling. Unfortunately, the original ATX case design made a major boo-boo by calling for the ATX power supply fan to blow air on the CPU. The idea was to save on power, cost, and noise pollution by having the power supply fan suck air into the PC and then blow it past the CPU. This isn't a great way to cool silicon, because the power supply itself actually heats up the air before blowing it onto the processor. The ATX spec has since been corrected to reverse the airflow, but many power supplies continue to run in this backasswards fashion.

Never assume that having a gazillion fans sucking hot air out of your case will net you efficient cooling. Your case should have a logical airflow that pulls in air from the front and exhausts it out the rear. Adding too many exhaust fans without any intake fans may do nothing more than generate noise. You should look for a balance of filtered air going into your system and an equivalent load coming out.

Relying on a fan/heatsink combo, or even multiple fans, to cool your CPU may not be enough. Without adequate ventilation, these strategies may do nothing more than blow CPU-heated air around your case. A good scenario for cooling off your CPU (without resorting to liquid cooling) is to use the fan mounted behind the CPU to suck air out of the case. Vendors such as Dell actually integrate mini wind tunnels that completely enclose the CPU. We've found that this strategy can keep even the 600MHz Pentium III Katmai cool without resorting to a fan mounted on the CPU (this Katmai proc is fabbed at 0.25-micron and has a reputation for running ultra-hot).

If you're thinking about drilling ventilation holes in your case, consider placing them near the base. Dead-air zones tend to hover around your PCI cards, where there's little

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air movement. If you poke holes on the side near the cards, outside air should be sucked through them and exhausted out the top through your power supply.

You really can't beat a big floor fan blowing into an open case for the ultimate in airflow, but this isn't a long-term solution. The floor fan method builds up dust, creates extra noise, and gives your nephew the chance to drop a box of paper clips into the heart of your pride and joy.

Generally, the faster the CPU, the more heat it produces—and really hot CPUs can suffer processing glitches and full shut-downs. That said, heat-ceiling specs vary from proc to proc. The hottest air temperature that's supposed to be directed at the inlet of a Slot 1 Celeron 300A heatsink is an amazing 154 degrees Fahrenheit. On the latest 533MHz Celeron in PPGA, that temperature drops to 116 degrees Fahrenheit. A 600MHz P-III Katmai on the old 0.25-micron process needs a chilly 113 degrees F at the fan inlet. If the room temperature is pushing 110 degrees Fahrenheit on a summer day, you'll have a hard time getting the air temperature inside the case to stay below Intel's recommendations.

We interviewed Dell engineers to learn more about how they design their own cases. If you think OEMs simply slap together PCs with little tender-lovin' care, you'll be surprised to learn that vendors face more stringent hurdles than the average hobbyist. One major hurdle is getting their PCs to pass the FCC's radio frequency emissions tests—every time you add a fan, you increase the RF emissions a box produces. But if your PC is well-shielded to reduce RF emissions, it's also well-shielded against interference from cell phones, CB radios, and microwave ovens. Theory has it that this interfer-

avance technologies 7009

PLUSES
Screwless design
Sweeping bezel
Pop-out mobo tray

MINUSES
Flimsy construction
Sweeping bezel

Advance Technologies offers a near screwless design with its 7008. To strip the 7008, you need to remove only four screws. The rest is magically held together by spring clips and plastic connectors. Need to access mobo jumpers? Simply pop the right side off the case and tilt the entire section out. Also absent are screws used to hold down PCI cards. If you need to pop out your NIC, simply slide open a plastic lock, and pull the card out. The same ingenuity is applied to the hard drive gondola, which is easily popped out with a clip.

Power supply placement—oh-so-critical in a mid-tower case—is well-designed, providing access to the CPU without having to pull components. We had mixed feelings about the case's aesthetics, though. Some staff members preferred the sweeping lines of the bezel, but others thought it looked downright ugly. While this all sounds great, we have some reservations about the case's construction. It simply isn't as sturdy as the Inwin. We attribute this to the design of the pop-out motherboard. It's really a wash

between the 7008 and the Inwin. And, of course, neither offers the amenities of the super-tower big boys. **$67, www.avance-technologies.com**

1 2 3 4 5 6 **7** 8 9 10

Rainier company color case

PLUSES
Lightweight
Feminine design (if that's your thing)

MINUSES
Very flimsy
Expensive

Your parents are bugging you to buy an iMac so they can get on this "superhighway" thing, but you absolutely refuse to give money to Steve Jobs and his anti-PC platform. So what do you do? You buy Rainier's Color Case, build a budget box, and tell your parents that it is an iMac. And that's probably the only legitimate reason to buy one of these gum-drops.

The Ranier has scant few drive bays and is light to a fault. In fact, the Color Case is constructed entirely of translucent plastic and aluminum, and there's only a single 8cm fan mounted in front. We give props to Ranier for constructing a case that's half as heavy as the other mid-tower cases here, and we do have to admit that the shiny aluminum is a nice change from the gray pot metal we're so used to (once you strip off the plastic, the aluminum case looks kinda cool in a Terminator 2 sorta way). But the aluminum makes the case susceptible to bending. In fact, we didn't even try to sit on the Color Case for strength testing—we're pretty sure it would

have collapsed like a beer can. The Color Case boasts a hefty price tag, so we can only recommend it if you're smitten with its pretty-boy facade. **$160, www.colorcase.com**

1 2 3 4 5 **6** 7 8 9 10

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cases

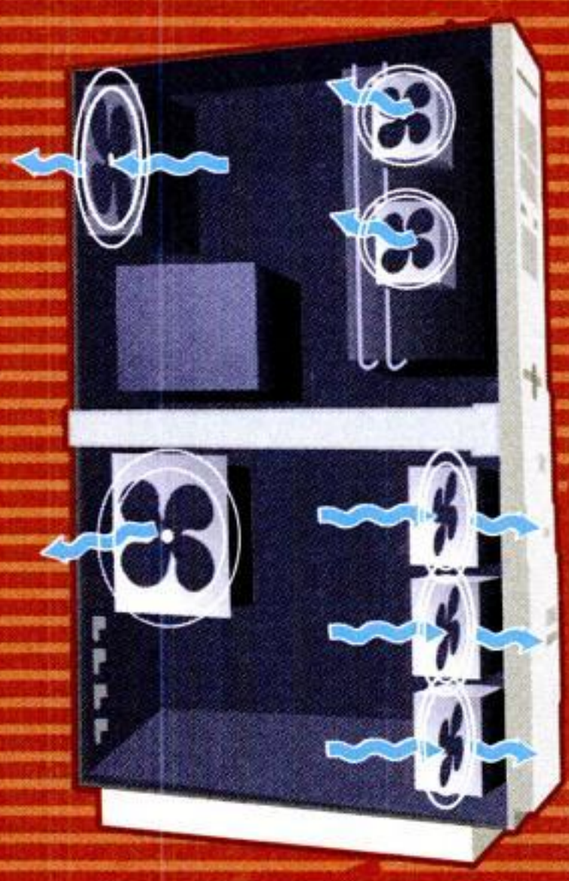
Even Flow

Is your CPU hotter than John McCain in an NVA sweatbox? If so, your fans may actually be working against you instead of for you. Here are three ways to cool your proc.

Ideal

Filtered air should be pulled from the front of the case while hot air is sucked out via the power supply fan. Using a shroud to envelope a fan-cooled CPU is another great way to cool the proc and keep its hot air from polluting the rest of your system.

Overkill



If you have a ridiculous number of fans sucking air out of your PC in random, arbitrary directions, you may be wasting great opportunities for efficient airflow. And who needs the excess noise?

Bad

The original ATX spec called for air to be sucked through the power supply and blown onto the CPU. This did nothing more than throw hot air on an already toasty CPU. Also note the dead air zones that normally exist around the PCI/ISA expansion cards and drive bays. These areas should be addressed with fans and ventilation.

ence can cause random lockups and other problems. We take this advice with a grain of salt, as we haven't had too many appliances or wireless phones blue-screen us. Still, the Dells of the world do—and must—care. Vendors also face problems with excessive noise. While true PC enthusiasts live for the sounds of industry, most users don't like the hum of chopping fan blades. Dell uses thermally controlled fans that increase RPMs as heat increases.

You Got the Power!

Oh, the irony: You'll turn up your nose at a non-DDR videocard, or purchase memory according to who fabbed the actual chips, but you'll settle for the cheapest power supply in the world. If there's one underappreciated system component, it's the power supply. But peep this: Running your system with inadequate power is certain to hurt performance and stability.

In fact, some blue screens that people blame on cheap RAM, unstable drivers, or Windows itself can actually be power supply-related. Witness the problems that Athlon-based systems have with power supplies that lack ample wattage.

Any discussion of power supplies begins with definitions of volts, amps, and watts. In highly simplistic terms, volts describe how fast electricity flows through a wire, while amps describe the amount of

Measuring Your Power Struggles

How much power do you need? If you're running a micro-ATX motherboard with embedded graphics and audio, and a single 5400rpm IDE drive, that wimpy 150W power supply may be enough. But if your rig pushes half a gig of RAM, dual procs, Ultra2 SCSI RAID, and a GeForce 256, even a 300W supply may leave you bent.

We've compiled a list of roughly how much power is consumed by common parts. By now you should know not to judge your power supply by overall wattage alone, so look at the demands on each separate line. Nonetheless, when looking at overall wattage, add the requirements of every device in your rig, then multiply that number by 1.5 (because you should be taxing from 30 percent to 70 percent of your power supply's capacity). Some of your individual components may actually list their specific power requirements, so use these numbers for more accurate calculations. And remember, if you need to figure out wattage, multiply the voltage by amps.

Component	Requirement	Line(s) Used
High-wattage AGP Card	20+W	+3.3V
Average PCI card	5W	+3.3V
Cached SCSI controller PCI card	20-25W	+3.3V
Floppy Drive	1W	+5V
10/100 NIC	4W	+3.3V
50x Atapi CD-ROM	10-15+W	+5V & +12V
10x Atapi DVD-ROM	10-15+W	+5V & +12V
8x/4x/32x SCSI CD-R/RW	17W	+5V & +12V
SCSI CD-ROM	12W	+5V & +12V
RAM	10W per 128MB	+3.3V
Ultra2 SCSI PCI Card	5W	+3.3V
5200rpm IDE Hard Drive	5-11W	+5V & +12V
7200rpm IDE Hard Drive	5-15W	+5V & +12V
7200rpm SCSI Ultra2 Drive	24W	+5V & +12V
10000rpm SCSI Drive	10-30+W	+5V & +12V
Motherboard	20W	+3.3V & +5V
550MHz Pentium III	30W	+3.3V
733MHz Pentium III	23.5W	+3.3V
300MHz Celeron "A"	18W	+3.3V
600MHz Athlon	45W	+3.3V

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cases: Dare to Compare

SPEC	ASL	SUPERMICRO	PC POWER & COOLING	INWIN	ADVANCED TECHNOLOGIES	RAINIER COMPANY
Model No.	Full Tower Case	SC-760A	Solid Steel Tower	IW-S500-ATX	7008	Blue Yuri
Class	full-tower	full-tower	full-tower	mid-tower	mid-tower	mid-tower
Dimensions HxWxL	22x9x19	26x8.5x17.5	24x7.5x22.75	16.5x8x18.5	17.25x7.75x17.5	17.5x8x19
5.25-inch bays	Four external	Six external	Eight external, two internal	Three external	Three external	Three external
3.5-inch bays	Two external, five internal	One external, three internal	None	Two external, two internal	One external, one internal	Two external
Fans	Two 12cm, one 9cm	One 8cm, one 9cm, space for seven additional 8cm	One 8cm silencer fan, space for two additional 8cm	None stock, space for two additional 8cm	One 8cm, two 4cm, space for one additional 8cm	One 8cm, space one additional 8cm
Power Supply	Antec PP-303	AbleCom 300W, ATX 2.01, redundant cooling	PC Power & Cooling Turbo-Cool 425W, ATX 3.0	Power Man FSP235-60-GTW 235W, ATX 2.01	Advance Technologies 235W, ATX 2.01	Fortran 300W, ATX 2.01
Removable Mobo Tray	No	No	No	No	Yes	No
Right side access	Fair	Some	No	No	Yes	Some
Interior Space	Good	Excellent	Excellent	Fair	Fair	Fair
Airflow	Excellent	Excellent	Good	Fair	Fair	Fair
Rigidity	Good	Good	Excellent	Good	Fair	Poor
Largest Mobo Supported	Extended ATX	Extended ATX	Extended ATX	ATX	ATX	ATX
Price	$200	$170	$250 (power supply not included)	$60	$67	$160
Verdict	9	9	9	7	7	6
Readershop.com	Connect w/ this product @ www.readershop.com/mpc0411 877.751.7467 ID#0411	Connect w/ this this product @ www.readershop.com/mpc0409 877.751.7467 ID#0409	Connect w/ this this product @ www.readershop.com/mpc0410 877.751.7467 ID#0410	Connect w/ this this product @ www.readershop.com/mpc0412 877.751.7467 ID#0412	Connect w/ this this product @ www.readershop.com/mpc0413 877.751.7467 ID#0413	Connect w/ this this product @ www.readershop.com/mpc0414 877.751.7467 ID#0414

electricity flowing through a wire. Watts, meanwhile, simply describe the overall power of an electrical current. Wattage is determined by multiplying volts by amps.

The average power supply pumps out a total of 235W to 300W; you need ample wattage to keep all your PC's components fed with electricity. If you deny your parts sufficient power, they'll take a dump on you and drag down your whole system.

While the overall wattage measurement is handy, it can also be misleading. For the real story, look at your power supply label. If you're lucky, you'll see such details as +5 volts@16 amps, +12 volts@6 amps, and +3.3 volts@14 amps. Each describes a separate power supply line that feeds juice to different types of components.

In the example above, our power supply puts out about 80W on the +5V line, 72W on the +12V line, and 46W on the +3.3V line. Generally, SCSI hard drives need butt-loads of +12V power, while PCI cards feed off the +5V or +3.3V lines.

If you do the math and find that your 300W power supply puts out 350W, don't be alarmed. The individual outputs tell you the maximum each line can put out when there's no other load on the power supply. Quality power supplies will also report the combined load of your +3.3V and +5V lines.

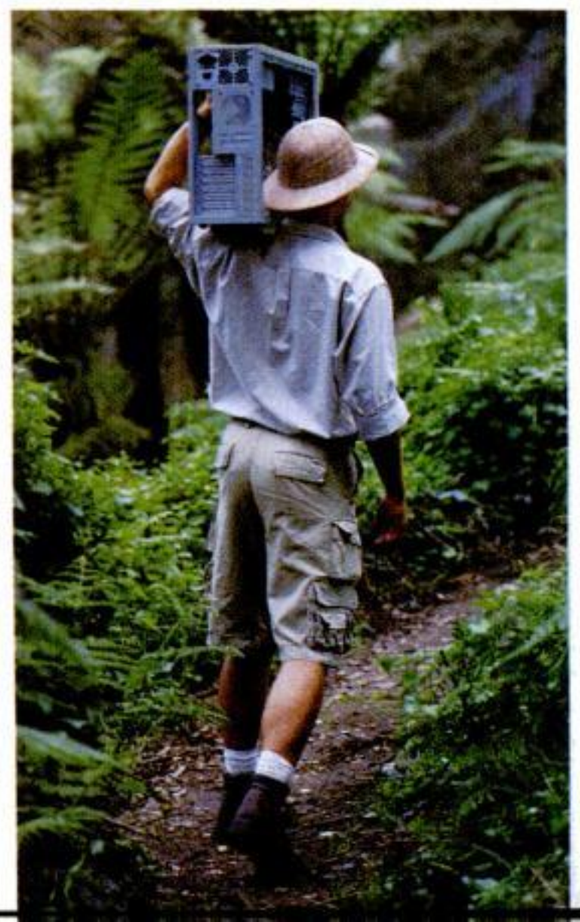
Servers, which run boatloads of high-speed hard drives, drink a lot of power from the +12V line and thus need more amperage there. Power-hungry AGP cards draw from the +3.3V and +5V lines and need more amperage there. To make you thoroughly confused, some motherboard makers now draw power from the +12V line and convert it for use on the +5V and +3.3V lines. The moral of the story? Pay attention to the amount of wattage you have available on each of the three lines. If you plan to go nutty with a SCSI RAID array, make sure your +12V line is willing and able.

Avoid coming close to stressing the total output of your power supply. In fact, conventional wisdom says you should only tax 70 percent of your supply's total wattage at any given time. Running at close to 100 percent forces the power supply to work harder, producing excess heat and shortening the supply's lifespan. Use the sidebar on page 61 to determine how much power your system needs.

If you're afraid that running a 425W power supply will increase your electricity bills, fear not. A "switching" power supply only puts out what's needed. If your PC needs 200W total, but you have a 400W supply, the system will only consume 200W. In fact, some power-supply vendors say the extra breathing room can actually save you money because the more powerful unit will run cooler and more efficiently than a cheap supply.

When judging a power supply, also consider over-volt and over-current protection. Over-voltage protection will tell the power supply to shut off if it detects that the voltage output is high. Over-current detects whether the power supply is producing excessive current (amperage). All good power supplies will feature both protections, but some sketchy brands may shave these features to save money. You need these features to protect your components from permanent damage. Don't skimp!

Also pay attention to the operating range of your power supply (the info should be available from the vendor's web site). A power supply with a wide operating range of 85V to 135V will be better able to handle brownouts, sags, and spikes than a supply with a narrower range of 90V to 132V. Power regulation is also critical. The tighter the power regulation, the closer the power supply comes to its target voltage. Witness, for example, PC Power & Cooling's Turbo-Cool 425W supply. Its regulation on all three lines is 1 percent. Cheaper power supplies generally range from 5 percent to 7 percent.



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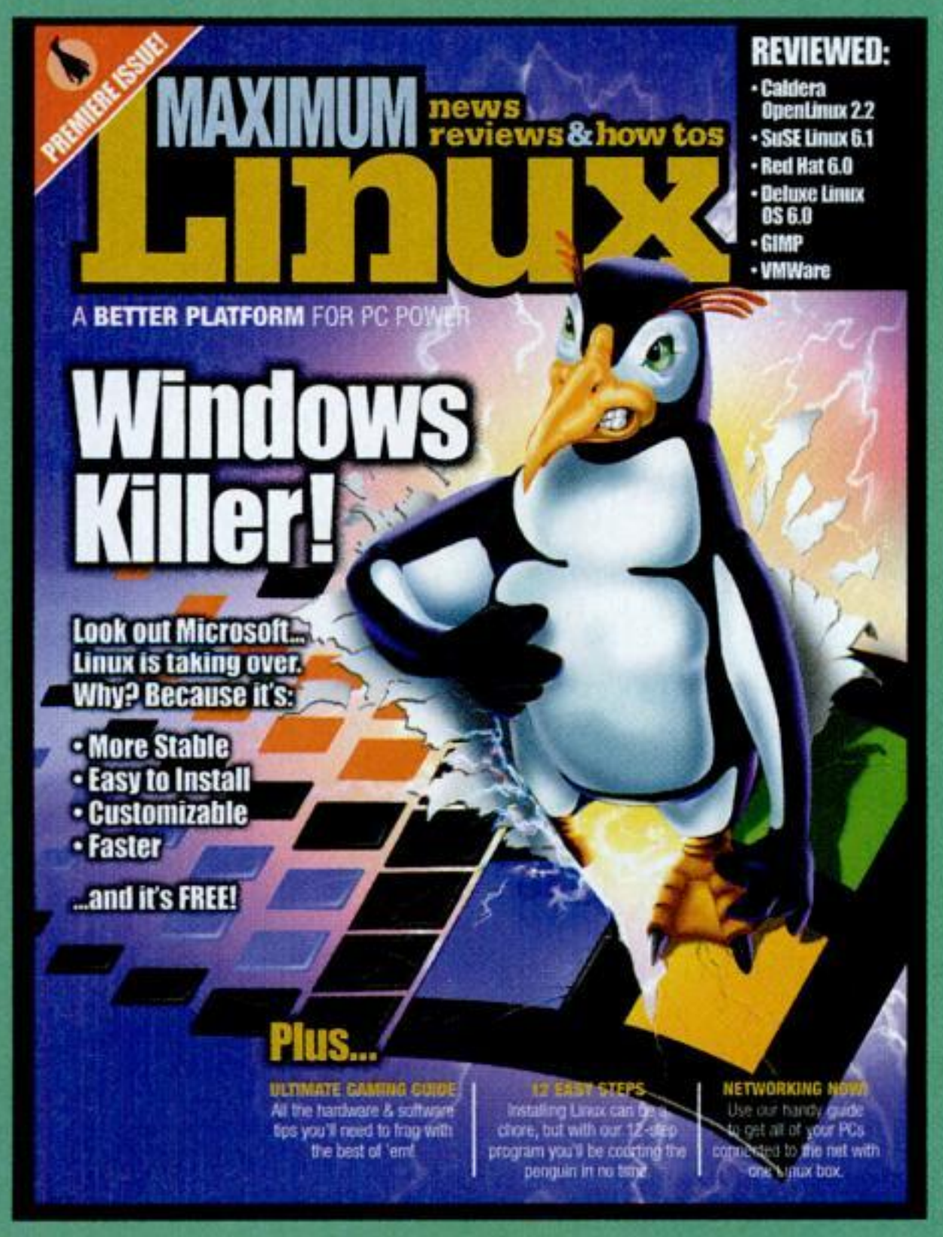
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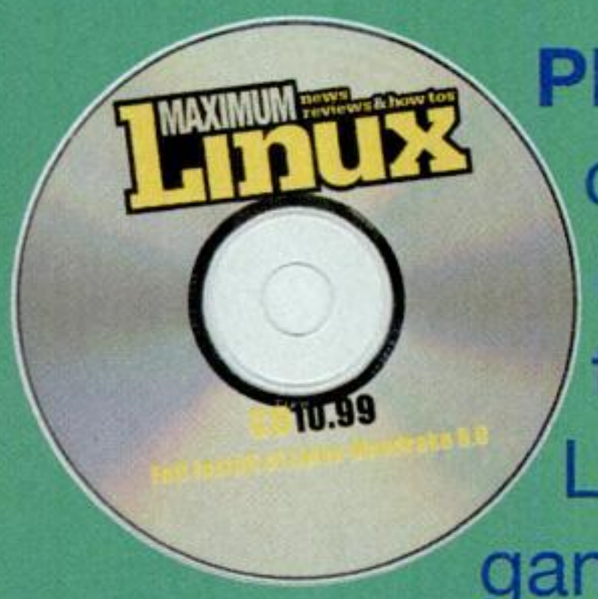

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How 3D Audio Works

You're Surrounded! If your PC isn't set up for 3D audio, you're missing out big-time. We explain the competing technologies, reveal the secrets of speaker placement, and show you how to surround yourself with sound.

—David Battino

When was the last time you heard someone say, "He's got ears in the back of his head"? Probably never. Our eyes only see what's right in front of us, but our ears pick up sounds from all around. If your PC isn't set up for three-dimensional audio, you're missing out on a lot. And while you'll go blind or broke trying to rig up a set of monitors that covers your entire field of vision, with a modest investment in audio hardware, you can wrap yourself in sound.

HERE'S MUD IN YOUR EAR

Marketers often use the terms "3D audio" and "surround sound" interchangeably, even when describing the goofy boom-box button that seems to do nothing. We'll use the more exacting definition here, calling the latter effect "expanded stereo" and reserving "3D" for a system that can place a sound in a specific position around the listener. For example, with a true 3D setup, you should be able to pinpoint sounds above, below, and behind you. Some researchers use the phrase "positional 3D audio" to emphasize this distinction.

On the PC, merely positioning sounds in space isn't enough; we also want them to move between positions as we interact with the sound-producing objects onscreen. When a missile roars by you in a game, you should *hear* its trajectory. This is the chief difference between true interactive 3D audio and surround sound, which just creates an immersive audio environment in which the listener is less conscious of individual speakers.

Surround-sound systems trickled down to computers from movie theaters, where multiple speakers are used to play back multiple channels of audio. (The term "channel" refers to a discrete signal path. Monophonic playback uses one channel; stereo uses two.)

All three types of audio—expanded stereo, positional 3D, and surround sound—can enhance your listening experience. Let's look more closely at each.

EXPANDED STEREO

Since its debut in the 1950s, conventional two-speaker stereo has been limited by its sound stage, the size of the acoustic image perceived by the listener. Another problem with stereo is its small sweet spot, the location where the listener must be positioned in order to hear the best image.

Many techniques have been used to expand the sound stage, and even to widen the sweet spot. Poorly executed with delays or crude filters, they can create an out-of-phase, seasick sound with feeble bass and peaky treble.

More sophisticated algorithms employed by companies such as SRS, Spatializer, QSound, Power Technology, and Philips, widen the sound stage far more elegantly. This is particularly helpful with computer speakers, because it's often physically difficult to position them far enough apart. But because these processes operate on a stereo signal, sound-stage expansion is limited and positional effects are impossible.

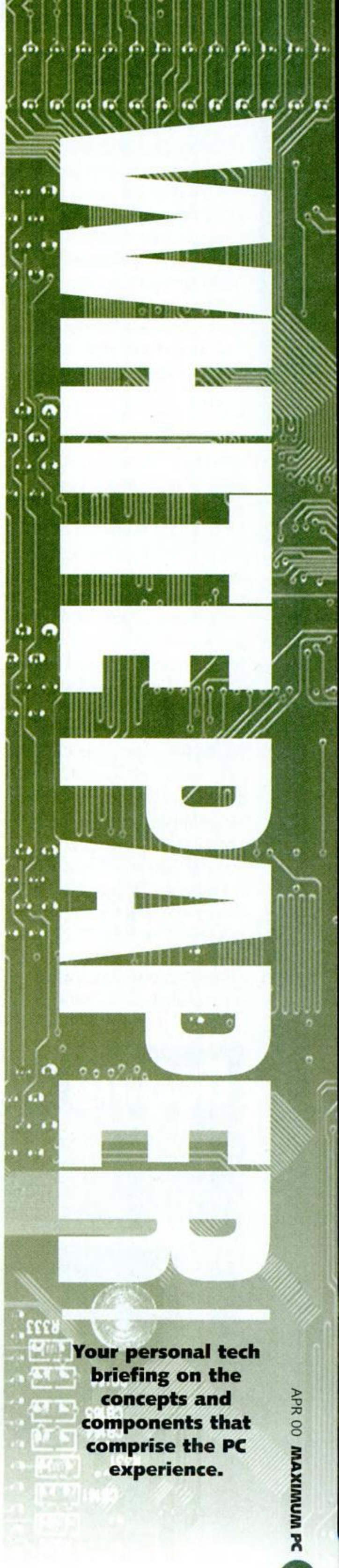
Still, if you're only after a bigger sound—and especially if your audio budget is puny—stereo expanders are worthwhile. Hardware versions (such as QSound's UltraQ) are typically connected between your soundcard and speakers, although many soundcards now include expansion algorithms. Software versions are available both as standalone applications and as plug-ins for programs like *Winamp*. Power Technology's *Widener* works as both.

SURROUND SOUND

There are three main PC surround-sound formats: Dolby Surround, Dolby Digital, and DTS. Dolby Surround is the oldest and employs four channels of audio; Dolby Digital and DTS both use six. When Dolby Surround soundtracks are recorded, all four channels of information—left, center, right, and "surround"—are encoded into a two-channel stereo signal. The center-channel information is added equally to the left and right channels, while the surround channel is split into two parts that are thrown 180 degrees out of phase with one another; one part is then added to the left channel of the stereo signal, and the other is added to the right.

If you play a Dolby Surround recording over two speakers, this phase-reversal expands the embedded surround information beyond the speakers, although some people complain that it colors the sound. But when the recording is played back through a Dolby Surround ProLogic decoder, the four channels can be extracted and sent to multiple speakers. The recommended setup uses five speakers (see the third diagram on page 67). The surround signal is monophonic, but it's sent equally to both rear speakers, creating a more diffuse effect. Many soundcards and stereo receivers offer additional signal processing that can simulate the center and surround channels in setups with fewer than five speakers, a process called virtualization.

Dolby Surround is used mostly for ambience.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The advantage of Dolby Surround is that it can be transmitted on just two channels, so you can plug any stereo soundcard directly into a ProLogic-equipped home-theater system to hear the effect. Consequently, many movies and games are encoded in Dolby Surround. And since it's easy to phase-reverse a sound and hide it in a stereo signal, some game designers toss pseudo-surround "ear candy" into their soundtracks, knowing a Dolby decoder will tease it out.

DISCRETE SURROUND

Unlike Dolby Surround, Dolby Digital and DTS store all channels separately, which permits more precise positioning of sounds. Both formats are popular in movie theaters (in fact, DTS stands for Digital Theater Systems). Due to the complexity of the encoding and decoding algorithms, it's currently impossible for these systems to reposition sounds fast enough for interactive gameplay. Hence, they're used mainly for pre-rendered cinematic soundtracks.

Dolby Digital is the official audio format for DVD and HDTV, while DTS is an alternative DVD audio format that's also used for multichannel audio CDs. In addition to left, center, and right channels, both Dolby Digital and DTS incorporate discrete, full-range left and right surround channels and a Low-Frequency Effects (subwoofer) channel. This is the "point one" of the 5.1-speaker configuration, so called because it's limited to frequencies below 120Hz, not the entire 20Hz to 20kHz audio range.

Both systems use "lossy" data-compression algorithms, which discard supposedly imperceptible audio information to reduce file size. There's intense controversy about which system sounds better. Dolby Digital's encoding system, AC-3, discards much more data than DTS, but both perceptually meet or exceed CD quality for many listeners, and the expanded sound stage you get from having six speakers further improves the perceived quality.

To get multichannel Dolby Digital or DTS sound out of your PC, you'll need a soundcard with a S/PDIF output jack that supports AC-3 or DTS passthrough. You then cable the S/PDIF jack to an external decoder box that has six speaker outputs. Some software DVD players, such as CyberLink's PowerDVD, include drivers that enable the passthrough function on certain soundcards. A number of soundcards can decode Dolby Digital and mix it down to their stereo or quad analog outputs, often adding processing to emulate the missing channels. Future soundcards will likely include six outputs.

DIRECTSOUND3D

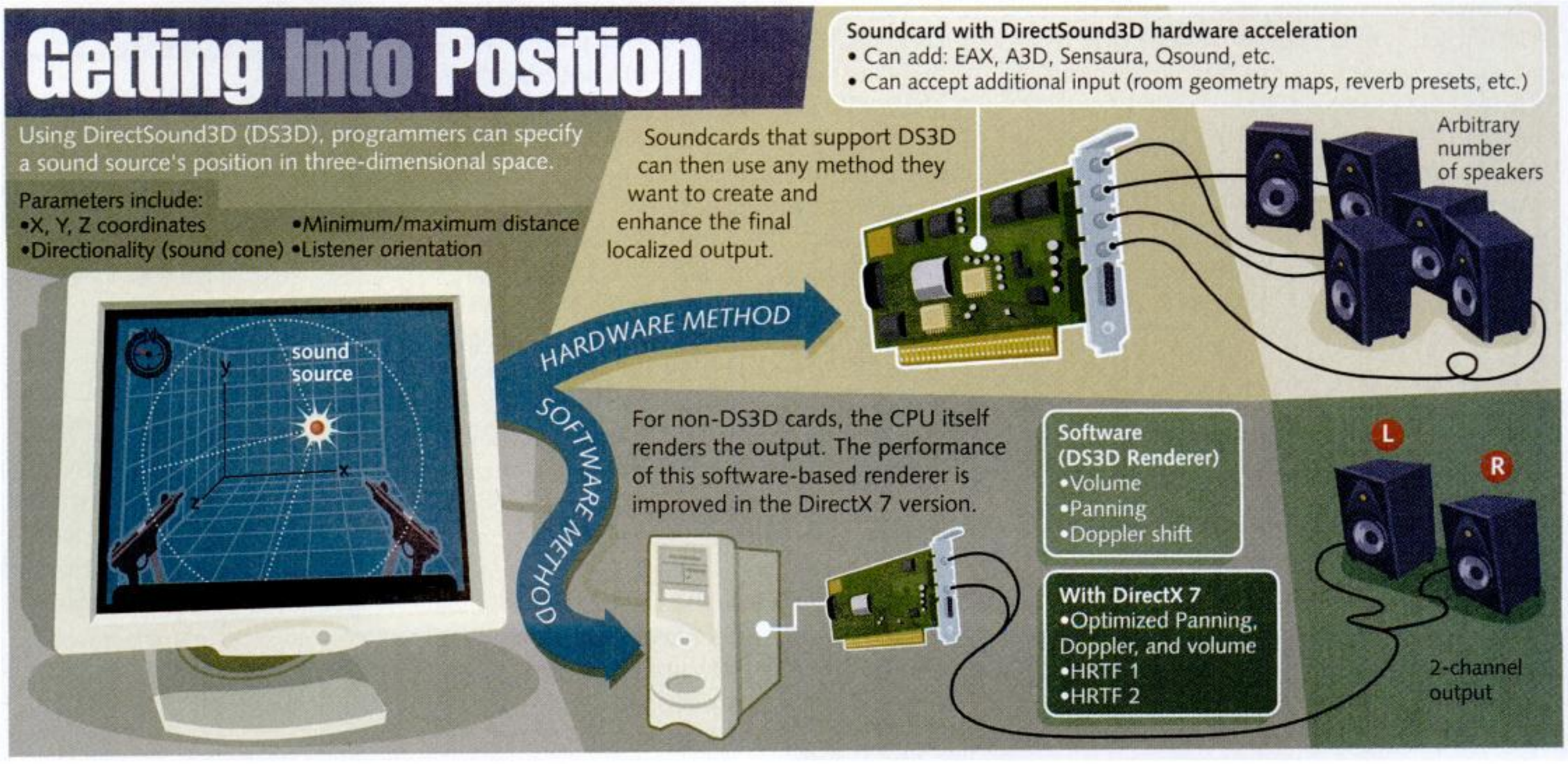
There are many ways to position sounds in 3D space, but with DirectSound3D (DS3D) version 5.0, Microsoft made the unusual move of not dictating which method developers must use. DS3D is a component of Microsoft's DirectX, the software middleman—or API—that enables games to directly address PC hardware. Developers can extend DS3D by writing property sets, additional code that enables the API to access proprietary soundcard hardware. Using DS3D, programmers specify the locations of sound sources and of the listener in x, y, and z coordinates (see the diagram on page 68). Factors such as the direction the listener is facing, the velocities of the sound sources, and the way they radiate sound (spherically or conically) can also be specified. If you have a DS3D-compatible soundcard, it can then read these parameters and use any method it wants to render the final output—through any number of speakers.

If no DS3D-accelerating soundcard is present, DS3D itself renders the output in software. Although convenient, this method significantly bogs down your CPU, and the results are crude. It also offers a more efficient 3D rendering algorithm along with two higher-quality ones based on head-related transfer functions (HRTFs), mathematical models of the way humans perceive sound location (see page 68).

Also new in DirectX 7.0 is hardware voice management, which lets applications determine the number of 3D objects the soundcard can render simultaneously and allocates requests accordingly. This is important because any overflow requests must be rendered on the CPU or converted to plain stereo. With voice management, developers can specify that important sounds get quality 3D processing. As an "agnostic" API, DS3D has helped to expand the number of games with 3D audio support.

EAX

Introduced with the SoundBlaster Live! soundcards, Creative Labs' Environmental Audio Extensions (EAX) began as a simple way to add reverberation to DS3D. Reverberation—the wash of echoes


Getting Into Position
Using DirectSound3D (DS3D), programmers can specify a sound source's position in three-dimensional space.
Parameters include:
•X, Y, Z coordinates
•Minimum/maximum distance
•Directionality (sound cone)
•Listener orientation
sound source
y
x
z
Soundcards that support DS3D can then use any method they want to create and enhance the final localized output.
Soundcard with DirectSound3D hardware acceleration
• Can add: EAX, A3D, Sensaura, Qsound, etc.
• Can accept additional input (room geometry maps, reverb presets, etc.)
Arbitrary number of speakers
HARDWARE METHOD
SOFTWARE METHOD
For non-DS3D cards, the CPU itself renders the output. The performance of this software-based renderer is improved in the DirectX 7 version.
Software (DS3D Renderer)
•Volume
•Panning
•Doppler shift
With DirectX 7
•Optimized Panning, Doppler, and volume
•HRTF 1
•HRTF 2
L
R
2-channel output

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produced when sound waves bounce off walls in a room—helps us identify an environment. Gunshots in an airplane hangar sound very different than they do in a sewer pipe, for example, but DS3D ignores this fact. EAX 1.0 provides 26 reverb presets that can be applied to DS3D objects; the ratio of the reverb to the direct signal is altered automatically to simulate changes in distance. SoundBlaster Live! cards can render the effects onboard and output final audio to two speakers, four speakers, or headphones. Creative recommends a four-speaker setup because it gives you two additional discrete channels for the reverb effects.

EAX 2.0 adds support for obstruction and occlusion, the muffling effects heard when a sound source moves behind an object or a wall, respectively. It also offers global early reflections, the echoes that immediately precede real-world reverb and provide a better perception of room size and sound-source location. EAX 3.0, due this year, will provide the ability to "morph" between environments. It will also enable programmers to position and control clusters of early reflections, as well as one-shot reflections for ricochet effects.

The EAX format is widely supported in games. Besides Creative Labs, several other hardware companies, including Sensaura and QSound, now support EAX 1.0 and 2.0, though the quality and performance of their reverbs varies since the soundcards they run on don't use Creative's EMU10K1 chip.

A3D

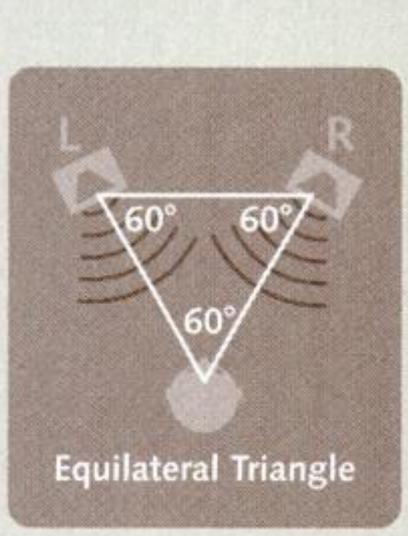
Although EAX is effective, Creative admits that it's a "Hollywood" approach: The company is more concerned with generating immersive environments than absolutely realistic ones. Aureal, in contrast, took a pure mathematical approach with A3D 2.0, opting to model onscreen environments as closely as possible. The A3D 2.0 API actually analyzes the geometry of game maps and uses wavetracing to calculate the sounds' early reflections and occlusions in realtime. This requires big computational muscle; Aureal's Vortex 2 chip packs 3.3 million transistors. Under A3D 2.0, the Vortex 2 can render up to 16 proprietary 3D streams, plus 60 reflections. In DS3D games (where there are no reflections), all 76 streams can be used for 3D.

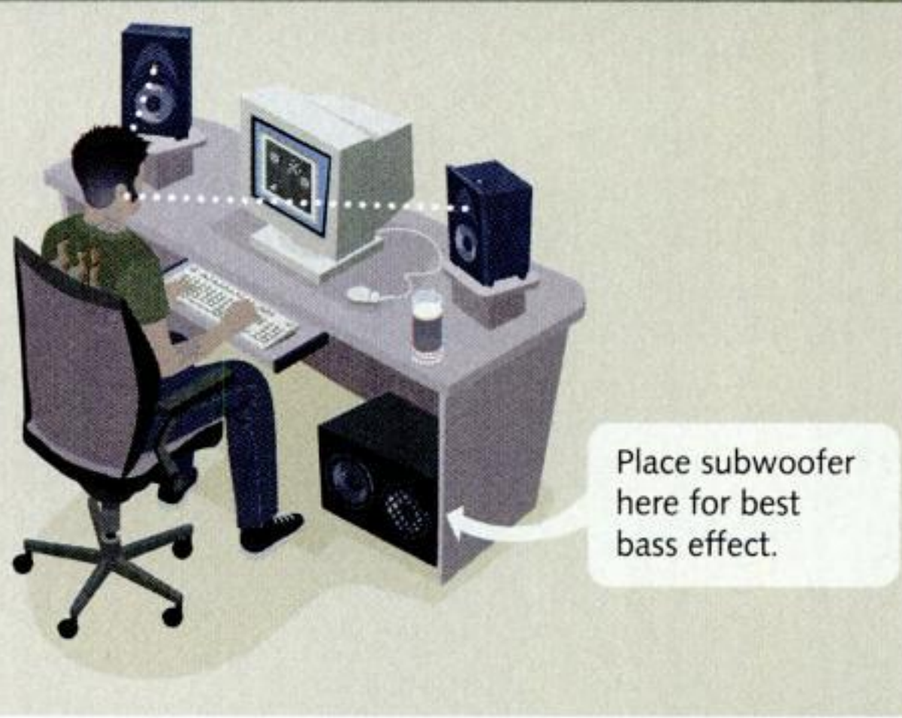
A3D 3.0 will up the ante with geometry-based reverb effects, as well as decoding for Dolby Digital and MP3. It also supports volumetric sound sources, such as cheering crowds, that are too big to be true point sources. The final output can be delivered to two speakers, four speakers, or headphones.

Be Careful Where You Speak

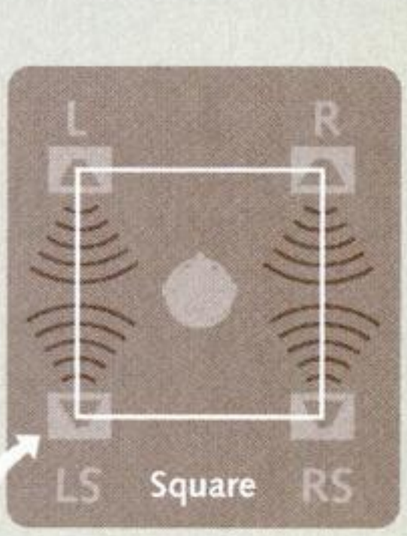
Because everyone's ears are different, you'll need to experiment with speaker placement to get the best 3D sound. The position of the front speakers is most critical. Make sure the tweeters are at the same height, preferably ear level. And pay close attention to symmetry. Misaligning a speaker or moving your head from the "sweet spot" can destroy the 3D effect.

2 Speakers or . . . 2 Speakers + subwoofer



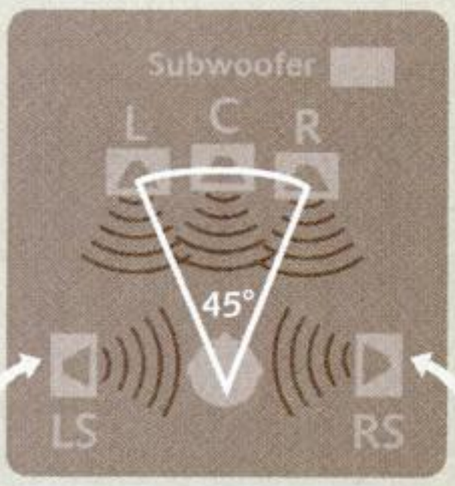


4 Speakers

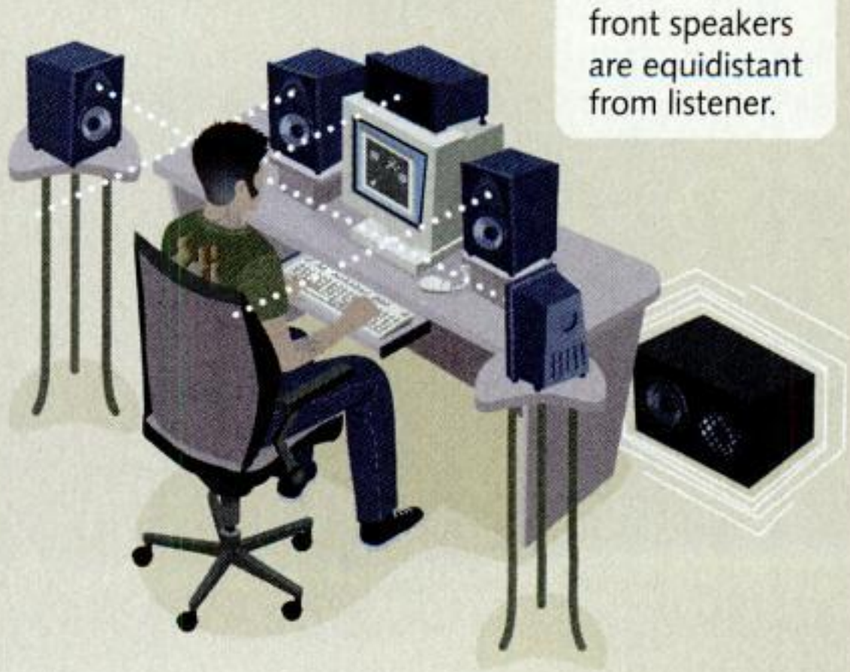


Surround speakers may also be angled in at 45°.

5 Speakers or . . . 5 Speakers + subwoofer



Surround speakers may also be faced forward, up, out, etc. for best effect.



Note that front speakers are equidistant from listener.

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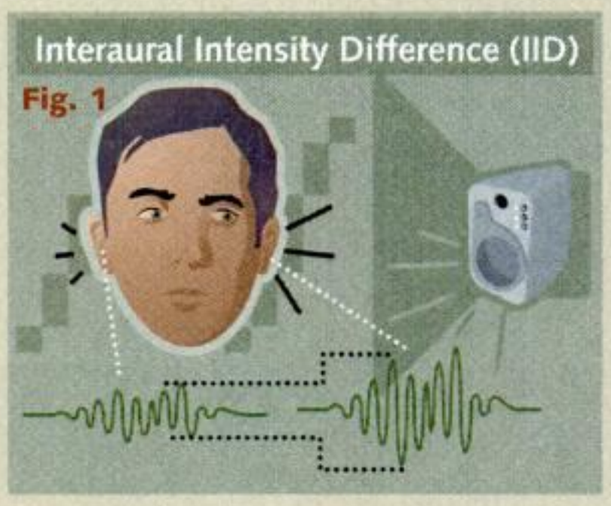
WHITE PAPER

How They Do It: HRTFs Explained

To understand how 3D audio algorithms work, you need to understand how your ears work. Two primary clues help us localize a sound: intensity and delay. Thus, a sound source to your left will be louder in your left ear than your right; the sound wave will also hit your left ear first. (See **Figures 1** and **2.**) The shape of the outer ear helps the brain refine the sound's location. Those complex folds create tiny resonances that combine to emphasize certain frequencies and reduce others, and your brain reads the patterns. Other factors, such as head shadow and shoulder bounce, also alter the sound. High frequencies are affected more than low ones, which is why tweeter placement is so important.



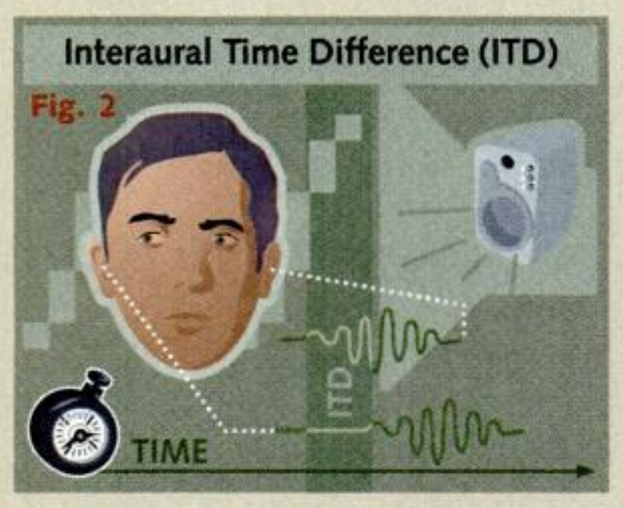


Fig. 1: Localization clue #1: A sound source that's closer to one ear than the other will seem louder in the nearby ear. Note the difference in the height of the waveforms.
Fig. 2: Localization clue #2: The nearby ear hears the sound a fraction of a second before the distant ear does. Note the silent area at the beginning of the second waveform.

One way to develop a 3D model is to put a listener (or a dummy head) in an echo-free room and install microphones in the ear canals. Researchers then move a sound source around the head at a constant distance—typically one meter—and measure differences between the spectral responses recorded in each ear. The set of measurements taken at each location is called a head-related transfer function (HRTF). It consists of three parts: the near-ear response, the far-ear response, and the interaural time delay (shown in **Figure 2**). Sensaura's 3D technology is based on 1,111 HRTFs.

The next step is to repeat the measurements for various heads and find statistical groupings that are used to create the final model. You can envision this model as two complex graphic equalizers, each connected to a delay processor and feeding a separate speaker. Running a new sound through this apparatus and adjusting the delays and equalizers to match the appropriate HRTF should make the sound appear to come from the desired location. If the synthetic 3D audio will be played back on speakers, programmers must also add transaural crosstalk cancellation signals to keep the sound of the left speaker from reaching the listener's right ear, and vice-versa.

In the end, there are problems in applying generalized models to a wide audience. Indeed, a pointed study at **www.u-aizu.ac.jp/~wlm/iwhit.html** called "Unexamined Assumptions in the Commercialization of 3D Audio" argues that HRTFs are overrated.

In four-speaker mode, HRTFs are used only on the front speakers. Aureal recommends headphones for the most realistic effect.

Also highly recommended for A3D are soundcards containing Aureal's Vortex chips, which include Diamond's MX300, Turtle Beach's Montego A3D II, and Aureal's own SQ2500 and SQ3 500. Some non-Vortex cards can emulate A3D 1.0, but they do it by converting A3D calls into DS3D ones, so the effect suffers.

SENSAURA

Whereas Aureal and Creative use panning, or simple level changes, to position sounds in the rear speakers of a four-speaker setup, Sensaura's MultiDrive algorithm employs HRTFs and crosstalk cancellation on all four speakers. When establishing a sound's location, the company claims, the time difference between the signals arriving at each ear is more important than the intensity difference. This means, they say, that panning is only effective when the listener is equidistant from all speakers. Moving out of that sweet spot changes the delays from each speaker, causing false imaging.

Sensaura also provides two-speaker and headphone 3D algorithms. Its MacroFX process simulates sounds that are very close to the listener, such as a whisper in the ear. ZoomFX simulates sound from volumetric sources. And EnvironmentFX offers reverb presets compatible with EAX 2.0 and I3DL2 (see below).

Soundcard manufacturers using Sensaura's 3D technology include Diamond, Guillemot, Terratec, and Yamaha.

Q3D

QSound's founders were recording engineers so, unlike such math-based companies as Aureal, they made heavy use of listening tests to refine their numerous spatialization algorithms, which range from mono expansion (Q123) to Dolby Digital virtualization (QSurround). QSound's highly efficient Q3D 2.0 process accelerates DS3D and includes an EAX 1.0-compatible reverb engine. Current versions of Q3D support headphones (using HRTFs) and an arbitrary number of speakers (using a mix of proprietary QSound 3D and panning).

Q3D is used on the Sega Dreamcast; soundcard manufacturers supporting the format include Aztech, Addonics, and Hoontech.

I3DL2

The 3D audio field has been far from harmonious, with disinformation and even lawsuits flying back and forth. But, thanks to work by the Interactive Audio Special Interest Group (IA-SIG), accord is emerging. The IA-SIG's 3D Audio Working Group developed the Interactive 3D Audio Rendering Guidelines, Level 1, which describe the minimum acceptable 3D audio features for all platforms. Level 2 of these guidelines, called I3DL2, owes much in its form and format to EAX. It calls for reverberation as well as obstruction and occlusion models, and is already being supported by a number of soundcard manufacturers. (All the 3D companies discussed here contributed to the document.) Level 3 may add morphing between multiple reverbs.

PLAY IT BY EAR

So which hardware should you choose? One approach is to pick the software first. Each 3D contender has a list of recommended games and/or movies on its site. A five-speaker setup will give you the most options, but most people don't miss the center channel when using only four speakers, and some can only hear 3D on headphones. Because the psychoacoustic processing used to create 3D effects is based on averages, no single format is best, but any one of these systems will bust you out of that boring stereo box. The best way to get high-quality audio—3D or otherwise—is to buy high-quality speakers, ensuring that if all 3D technologies are eclipsed tomorrow, you'll still be smiling from ear to ear.

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

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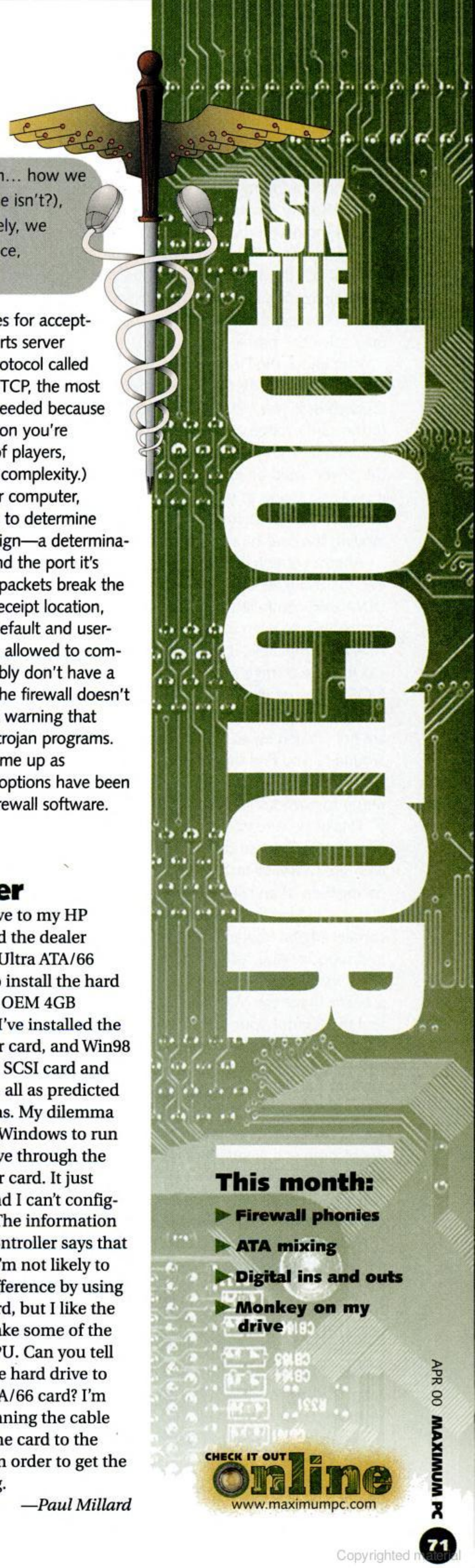
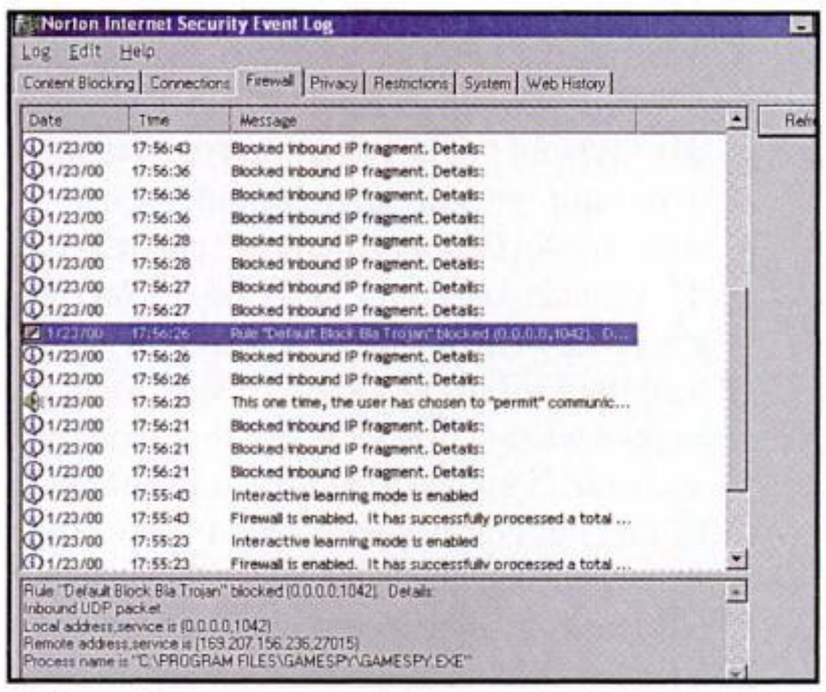
It's almost Spring, and the fresh scent of PC malfunction is nipping at our noses. Ahhhh... how we love the smell of burning hard drives in the morning. If your PC is acting up (and whose isn't?), we may be able to help. Send your problems to **doctor@maximumpc.com**. Unfortunately, we can't respond to every individual letter, so if you need immediate, personalized assistance, consult your vendor's tech support.



Gamespy is haXOring me!

I recently installed Norton *Internet Security* on my computer, and every time I run *Gamespy* in order to find online game servers, I receive numerous notifications that it's probing my ports for trojan programs (programs that can be operated via remote commands). At first I thought it was a simple mistake, but after seeing probes for "Deep Throat Trojan," "Portal of Doom Trojan," and "Master Paradise Trojan," I'm beginning to think I'm being hacked. It says the rule that was violated is an incoming UDP packet, but that *Gamespy* is the program that's receiving the packet. I honestly don't think *Gamespy* is scanning my ports for Trojans, but almost every time I use *Gamespy* to look for game servers, I get a port probe. Is *Gamespy* hacking me, or is it something else?

—Jamie Nelson


Norton Internet Security Event Log
Log Edit Help
Content Blocking | Connections | Firewall | Privacy | Restrictions | System | Web History
Date Time Message
1/23/00 17:56:43 Blocked inbound IP fragment. Details:
1/23/00 17:56:36 Blocked inbound IP fragment. Details:
1/23/00 17:56:36 Blocked inbound IP fragment. Details:
1/23/00 17:56:36 Blocked inbound IP fragment. Details:
1/23/00 17:56:28 Blocked inbound IP fragment. Details:
1/23/00 17:56:28 Blocked inbound IP fragment. Details:
1/23/00 17:56:27 Blocked inbound IP fragment. Details:
1/23/00 17:56:27 Blocked inbound IP fragment. Details:
1/23/00 17:56:26 Rule "Default Block Bla Trojan" blocked (0.0.0.0,1042). D...
1/23/00 17:56:26 Blocked inbound IP fragment. Details:
1/23/00 17:56:26 Blocked inbound IP fragment. Details:
1/23/00 17:56:23 This one time, the user has chosen to "permit" communic...
1/23/00 17:56:21 Blocked inbound IP fragment. Details:
1/23/00 17:56:21 Blocked inbound IP fragment. Details:
1/23/00 17:56:21 Blocked inbound IP fragment. Details:
1/23/00 17:55:43 Interactive learning mode is enabled
1/23/00 17:55:43 Firewall is enabled. It has successfully processed a total ...
1/23/00 17:55:23 Interactive learning mode is enabled
1/23/00 17:55:23 Firewall is enabled. It has successfully processed a total ...
Rule "Default Block Bla Trojan" blocked (0.0.0.0,1042). Details:
Inbound UDP packet
Local address,service is (0.0.0.0,1042)
Remote address,service is (169.207.156.236,27015)
Process name is "C:\PROGRAM FILES\GAMESPY\GAMESPY.EXE"

Software firewalls can be fooled into thinking they're being hacked when programs such as *Gamespy* receive server information on certain ports.

Gamespy isn't hacking you, but your computer thinks it is, since it's receiving out-of-the-ordinary packets on ports commonly used for trojan communications. The Doctor talked to Symantec, and the company broke it down like this: Your firewall comes configured with a set of rules that act like border patrol agents. Every time a packet tries to enter or exit your system, the firewall examines the packet and cross-references it against the program's rules for acceptable transmissions. *Gamespy* reports server information to your PC using a protocol called UDP, or user datagram protocol. (TCP, the most common Internet protocol, isn't needed because the amount and type of information you're requesting—ping, map, number of players, etc.—doesn't require that kind of complexity.) When these packets arrive at your computer, the firewall looks at its list of rules to determine whether the data is hostile or benign—a determination based on the type of data, and the port it's being received on. If none of the packets break the firewall's rules for data type and receipt location, the firewall switches to its list of default and user-programmed applications that are allowed to communicate on that port. You probably don't have a rule configured for *Gamespy*, so the firewall doesn't find it in the list, and defaults to a warning that your ports are being scanned for trojan programs. Symantec says trojan warnings come up as a "last resort," meaning all other options have been examined and discarded by the firewall software.

Out of control ATA/66 controller

I added a 20GB Maxtor hard drive to my HP Pavilion 8260 (P-II 266MHz), and the dealer threw in a free Digital Research Ultra ATA/66 controller card. I've been able to install the hard drive and run it as a slave to my OEM 4GB Bigfoot hard drive. I've installed the ATA/66 controller card, and Win98 recognizes it as a SCSI card and loads the drivers, all as predicted in the instructions. My dilemma is that I can't get Windows to run my new hard drive through the ATA/66 controller card. It just doesn't find it, and I can't configure it manually. The information on the ATA/66 controller says that as a home user, I'm not likely to see much of a difference by using the controller card, but I like the idea that it will take some of the load off of the CPU. Can you tell me how to get the hard drive to work with the ATA/66 card? I'm currently just running the cable that came with the card to the motherboard, in order to get the Maxtor running.

—Paul Millard

> **"My dilemma is that I can't get Windows to run my new hard drive through the ATA/66 controller card. It just doesn't find it, and I can't configure it manually."**

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Be sure you haven't plugged the card into a shared PCI/ISA slot; the voltages associated with that configuration may cause problems. Also, try moving the card to another slot on the motherboard, even if it means trading places with another card. Changing a card's PCI slot forces the BIOS to re-recognize the card, and allows your system to reassign resources to it, which may solve the problem.

Also check the Device Manager by right-clicking on My Computer and selecting Properties. If you see a yellow symbol next to the card's name, it's an indication that a resource has not been properly configured; the driver could be loaded improperly, or it could be trying to share resources with other devices (IRQ conflict). Again, try moving the card to a different slot.

Another option is to plug the Bigfoot drive into the controller and boot it that way—UDMA/66 controllers are fully backward-compatible, so even though your drive isn't ATA/66 compatible, it will still work. You'll just need to change a few settings in the BIOS to ensure that it knows to boot from a third-party IDE controller. Since all BIOSes are not created equal, you'll have to muck around till you find the right setting. Just be sure you write everything down so you can return to previous settings if necessary.

Finally, be sure you're using the latest drivers. We checked the Digital Research web site (**www.dr-tech.com**) but could find no mention of an UltraDMA/66 controller. If that is indeed the site for your controller, contact Digital Research for updated drivers and support. Also, your Bigfoot drive is so slow, we recommend that you do yourself a favor: Make the Maxtor your primary drive and the Bigfoot your secondary drive, and use the Bigfoot to store just data, not applications. You'll notice a dramatic speed increase. If you don't want to reinstall Windows, we recommend creating a 5GB partition on the Maxtor drive and moving your data to the secondary partition. Use either *DriveImage* from PowerQuest or *Ghost* from Symantec to move the data over.

Digital speaker dilemma

After reading many reviews on soundcards and speakers, I have purchased a SoundBlaster Live! X-Gamer card. It sports two digital outputs that I'd like to make use of, instead of the two line outputs. However, it seems the best speakers available don't have digital inputs (the Klipsch Promedia V2-400, for example). I use my PC audio for games, watching DVDs, and listening to CDs. Should I be concerned about not using the digital outs and just get the Klipsch speakers, or should I search for speakers that accept digital input? I have not seen any reviews of speakers sporting digital inputs, although I did stumble across some on Altec Lansing's web site. Any advice would be greatly appreciated, as I have been researching for a while and have seemingly come to a dead end.

—Steven Urban

SoundBlaster Live! soundcards have a "digital out" port that lets you hook up DAT players or speakers with Dolby Digital decoders.

Even if you buy a set of speakers that have both analog and digital inputs, the difference in sound quality you'll get by switching between them will likely be imperceptible. With audiophile speakers (say, $1,000 a pair) and a quality external digital-to-analog converter (DAC), you *may* hear less noise and a clearer sound. But the main benefit of the SB Live's digital outputs is that they allow you to digitally connect peripheral devices such as MiniDisc recorders, DAT recorders, and surround-sound decoders (several example hookups are illustrated in the SB manual). This bypasses the digital-to-analog and analog-to-digital conversions that can degrade the signal. You may also notice a decrease in electromagnetic interference (hum and buzz), though running all your equipment off the same ground wire and keeping audio cables away from power cables and transformers can usually eliminate this.

> **"Should I be concerned about not using the digital outs, or should I search for speakers that accept digital inputs?"**

Ironically, because the SB Live runs at 48kHz, its digital audio output may have to be downsampled to 44.1kHz during the transfer to the other devices, in which case you wouldn't get a perfect copy of the signal anyway. Also, lowering the software volume control in your computer will reduce the output signal's bit resolution, further degrading it. We recommend you just invest your money in some quality speakers.

A monkey ate my hard drive

A few months ago, I purchased a used hard drive from a small local computer shop. It's a 730MB NEC drive, labeled "NEC-D3725-301." When I finally got around to installing it, my anti-virus program "found monkey virus in conventional memory" and asked if I wanted to clean the virus out. I selected yes. Since then, the drive reports only 520MB of space available. I tried taking it back to where I bought it, but they wouldn't accept it. I've since tried to fix it myself using FDISK, but now it reports only 195MB of space available! I've sent multiple e-mails to NEC looking for answers, but I've never heard back from them. Please help me with this problem.

—Doug Docherty

We're guessing you're using an older machine, and older machines typically contain a BIOS that cannot detect drives larger than 528MB. The reason for this is too lengthy to explain here. Regardless, you'll need some software to address this problem. We recommend using *EZ-Drive* from StorageSoft ($20, **www.storagesoft.com**).

If you happen to have a drive from a major vendor, such as Seagate, Quantum, or Maxtor, we suggest you download the OEM version of either *EZ-Drive* or *Disk Wizard*, available from Ontrack (**www.ontrack.com**). Generally, these programs will allow your geezer system to identify newer, larger drives, and will work on any drive in your system as long as one of the vendors' drives is present.

Also, when removing viruses, it's a good idea to create a clean, bootable floppy that contains the anti-virus software and has been write-protected. Most anti-virus software packages have utilities for creating a bootable disk cleaner; just be sure to create the disk on a virus-free machine. This is the only way to ensure that a virus has indeed been killed, as they have a tendency to copy themselves to the master boot record or memory areas so that they reload themselves next time you restart your computer. ✹

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THE MONTH IN

REVIEWS

The Maximum Lab Rat Lifestyle

Welcome to the *Maximum PC* reviews section. In the following pages, we dissect the latest hardware and software, and deliver our final referendum on what's bunk and what's hot. If a product *really* impresses us, it earns our coveted Kick Ass award. But what you see within the review section is only a small part of the entire process we loosely call "work." Many shenanigans occur behind the scenes; in these two pages, we take you inside the *Maximum PC* Lab. We'll relay some benchmarking 411, show you how we torture system vendors, and share the truly crappy products that don't even deserve the honor of an actual *Maximum PC* verdict. If you'd like a full breakdown of what our published benchmarks mean, go to **www.maximumpc.com/benchmarking**. Next stop: the Review Zone.

— JOSH NOREM, REVIEWS EDITOR

BEHIND THE BENCHMARKS

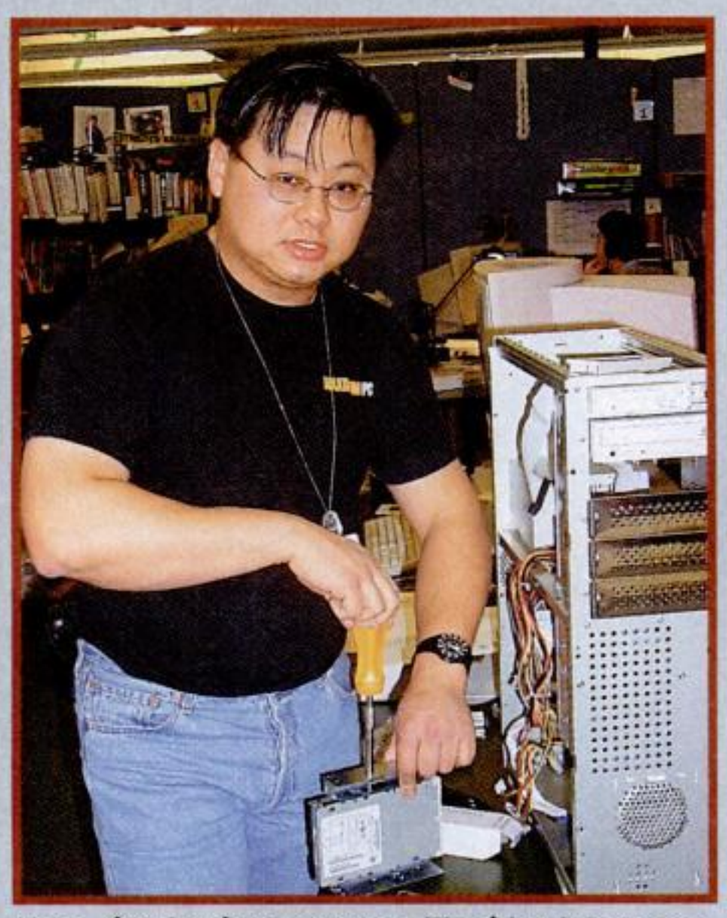
This month: Monitors

It's almost impossible to judge a CRT without comparing it side-by-side to other CRTs. To this end, we take a single 1280x1024 signal from a GeForce videocard and pipe it into an Extron splitter box, which maintains full signal integrity as it sends the original signal to as many as six different monitors. We then simultaneously run the same *DisplayMate* test screens on each CRT, and compare performance. *DisplayMate* puts monitors through a grueling obstacle course of test patterns that evoke the worst problems your CRT might ever suffer.

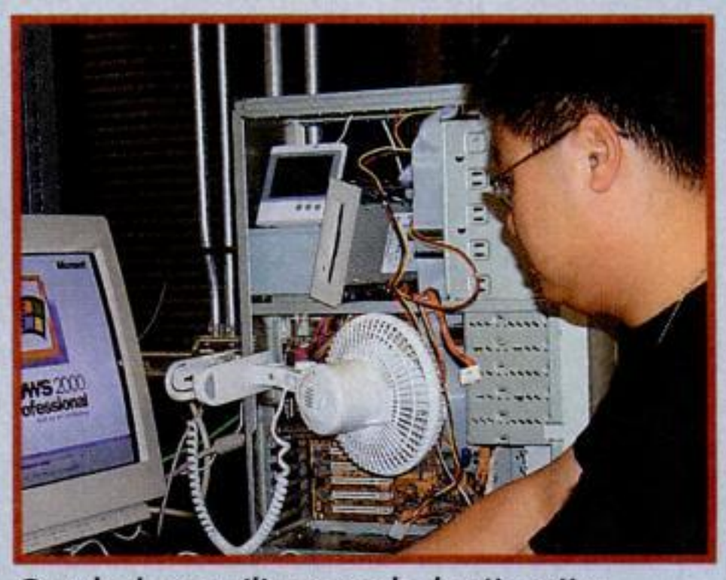
No two CRTs of the same model ever perform identically, so let your eyes be the final judge. When shopping in stores, use Windows' *Paint* program to test black and white levels. Also use *Paint* to check corner geometry: Build a perfect circle by using the shift key, and see if it becomes an oval when placed in screen corners.

The CPU! She's a'spittin flames!

To test Windows 2000, Gordon built a dual Pentium III 500MHz box anchored by Iwill's DS133R mobo. Gordon actually started this project in the newsroom because his workbench in the Lab was in a particularly egregious state of disarray.



Here, the Gordster screws a Zip drive into a wee drive bay adapter. The case is an Inwin Q-500, which we prefer over the S-500 on page 59.



Our dual-proc silicon needs drastic active cooling. Without the fan, the CPUs hit 120 degrees F and showed no signs of stopping.

"What's this? Someone removed the fan? No bother. I'll just touch the CPU to see if it's still running hot."

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A behind-the-scenes look at the Maximum PC Lab and the gearheads who work in it.

29 PRODUCTS REVIEWED!

RIGHTEOUS WEB SITE: SPEEDGUIDE.NET

If you have high-speed net access, check out **www.speedguide.net**. This site has every essential file you'll need to add to your Windows Registry in order to make your broadband pipe fly, and its tweak guides are second to none. One of our staffers increased his DSL download speeds by 700 percent with just one patch (mtupatch98) from this site. And Speedguide even has patches for Win2000 users. Also check out the reader forums, overclocking section, and utilities section. This site has it all. Go there now!

SpeedGuide.net
PC Performance Resources

PUTTING DELL THROUGH HELL

When Dell won a perfect 10 verdict for its 800MHz Pentium III machine last month, our editor-in-chief issued a challenge: Could the system—and Dell itself—survive extended torture tests? This month, we began the inquisition with phone calls to Dell's sales division. Overall, Dell's answers were truthful and informed. When we asked if we needed a Pentium III to "get on the Internet," the reps told us that other CPUs would work fine, too.

However, we did hear two choice nuggets. One rep assured us that any Dell PC is fully upgradeable—except for the motherboard. "Once they're installed, they're installed," he said. "You could do it yourself, but I personally don't think it's worth it." Another rep told us that if we got a "good" 32MB videocard like the nVidia TNT (not even a TNT2, mind you), we'd "be cooking" with today's latest 3D games.

Check back next month for the latest round of Dell torture tests.

Lemon of the Month

Logitech GameCam

With a small digital camera, the GameCam layers your visage over various game environments in an attempt to make you believe you're actually "interacting" with the onscreen action. Oh boy, my face is being shown on top of a monkey's body! Answer: A narcotic known as crack. For $100, Alex, What is Logitech smoking?

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RS

Hardware

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Benchmarking: Full Disclosure

Please go to **www.maximumpc.com/benchmarking** for the complete explanation of *Maximum PC*'s benchmarking policies.

Hardware Photography by **AARON LAUER**

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Polywell 800 K7

JUST SHY OF KICK ASS

The Polywell offers a good blend of beauty and brawn.

Last month's 750MHz Falcon Northwest Mach V was the first Athlon system we'd ever tested that brought tears to our eyes—not because of its overwhelming power, mind you, but because of its frustrating lack of oomph. We're happy to report that this month's 800MHz Athlon system from Polywell has restored our faith in AMD silicon. Though it's not loaded with top-shelf components like some of the systems we've seen recently from Dell, Micron, and Alienware, the Polywell's 800MHz processor, GeForce card and dual ATA/66 hard drives in a RAID 0 config were benchmark breakers.

The Polywell's silvery, alien-paint-jobbed box packs the fastest Athlon available, with firepower in all the right places. The double-barrel data shotgun is comprised of dual 13.6GB IBM Deskstar ATA/66 hard drives in a RAID 0 configuration that improves performance by disk striping, which involves breaking files into chunks and writing across both disks simultaneously. Both drives are connected to a Promise ATA/66 RAID controller, which is located just two doors down from the 32MB GeForce graphics card that's chock full of nutritious SDRAM. "Mmmm," we thought. "This system should eat our benchmarks for lunch."

As an appetizer, the Polywell devoured *SYSmark*, our desktop application performance benchmark, and coughed up the highest score ever at 327. That's 28 points higher than February's 750MHz Athlon, and nine points higher than last month's 10/Kick Ass Coppermine 800. But just as we started rooting for the Polywell, its *bootMark* score came in over 50 points shy of the 800 Coppermine's score. "Boo!" we shouted, and moved onto a benchmark we knew the Poly would dominate: HD Tach. Sure enough, with a score of 27MB/sec average read speed, the Polywell put the rest of the single-drive rigs we've tested on the trailer.

PLUSES
- Excessive power
- G'Thang graphics card
- 800MHz Athlon
- Striped drives

MINUSES
- Round monitor
- No Zip
- Weak speakers

UNDER THE HOOD

THE BRAINS

CPU	Athlon 800MHz
L2 Cache	256k closely coupled, 2/5 core speed
RAM	128MB PC100 SDRAM (768MB max)
Motherboard	MSI 6167, AMD 750 chipset
Drive Bays	Two 5.25-inch, five 3.5-inch (two free)
I/O ports	Two USB, two serial, one parallel, gameport

DISPLAY

Video	nVidia GeForce 256 32MB SDRAM
Monitor	19-inch Viewsonic E790 (18-inch viewable, 0.26 grille pitch)
Refresh/Res	75Hz@1600x1200

STORAGE

Hard Drive	Two 13.6GB IBM Deskstar 34GXP, ATA/66, 7200rpm, Promise Fastrack IDE RAID Controller, Raid 0
DVD	8x NEC DV-5500A
CD-RW	6x/4x/24x Ricoh MP7060A
Removable	Floppy

SOUND

Sound	SoundBlaster Live! Value
Speakers	Cambridge Soundworks PC Works FourPoint Surround

OTHERS

Lucent V.90 56k PCI modem

THE BUNDLE

CeQuadrat *WinOnCD* and *CheckCD* | GraphicCorp *CDInsert Creator* | *CD Label Editor* | *Graphic Viewer 32* | InterVideo *WinDVD*

BOOT **1:07** DOWN **0:02**

The Polywell's main course was our gaming benchmark. In *Expendable*, it cranked out the best score ever for a 32MB graphics card, at 81 fps. In *Quake II*, it turned in a better-than-average SDR GeForce score of 110 fps.

For multimedia and storage purposes, the Polywell is a sad case of "one step forward, two steps back;" almost every good part is matched with a clunker. For example, the 6/4/24 CD-RW drive is certainly fast enough for CD mastering, and we appreciate its inclusion, but it came at the expense of a Zip drive. The 8x DVD-ROM is fine for watching movies, but the Viewsonic 19-inch monitor is awful, with moire lines at lower resolutions and blurring at higher settings. The SoundBlaster Live! Value soundcard delivers crisp, clear tones, but sounds wimpy through the Cambridge Soundworks 4.1 speakers.

The Polywell performs impressively, and looks good while doing so. We loved the Athlon, GeForce, and RAID array, but it's a shame that such a shining package had to be tainted by the inclusion of several ho-hum parts.

—Josh Norem

MAXIMUM PC VERDICT

$2,995 ($2,595 without monitor)
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877.751.7467 | ID#0415

9

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EXPANSION NOTES

The Polywell's interior is a bit cramped, and the wiring is helter skelter. Two free PCI slots and one ISA slot limit expandability, but there really isn't much to add to this box.

EXPANSION MAP

- **AGP** Graphics card
- **PCI** Free
- **PCI** Promise RAID
- **PCI** Modem
- **PCI** Soundcard
- **PCI/ISA** Free
- **ISA** Free

IROS

00 System timer	**10** Modem
01 keyboard	**10** GeForce
02 Interrupt controller	**11** IRQ holder
03 Com 2	**12** IRQ holder
04 Com 1	**12** SB Live! Value
05 IRQ holder	**13** Numeric data proc
05 USB controller	**14** Primary IDE controller
06 Floppy	**14** Bus master control
07 Printer port	**15** Bus master control
08 System CMOS	**15** Secondary IDE controller
09 ACPI bus	
10 IRQ holder	

DMAS

01 SB16 Emulation	**04** DMA Controller
02 Floppy	**05** SB16 Emulation

It's not a DDR board, but it's got DVI Although it's an SDR GeForce, it's got a DVI output like its more muscular DDR relatives.

Quick-silver The vatos locos at Polywell tagged this box with silver spray paint for that custom look. Our staff was split on the color choice, but we give Polywell an A for effort.

Raid 0 is our hero A Promise ATA/66 PCI RAID controller and dual IBM 34GXP Deskstar drives mean 27GB of storage, burst speeds of 61MB/sec, and read speeds of 27MB/sec.

Wimpy speakers chapped our hide Polywell painted the case and components, why not the speakers and monitor, too? This system deserves speakers with more muscle than a dinky Cambridge fourpoint setup.

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3D Soundcard Slugfest

EAX, A3D, AND SENSAURA GET IT ON

Competition in the 3D soundcard market has never been more cut-throat, with every 3D audio developer bragging that its sound-positioning technology kicks the others to the curb. Gathered here today, ladies and gentlemen, are three cards based on different technologies: Creative Labs' **Sound Blaster Live! MP3+,** Aureal's **Vortex2 SQ2500,** and Diamond Multimedia's **Monster Sound MX400.**

PLUSES

SQ2500
- Fluid panning
- Intuitive interface

MX400
- SoftDVD player
- Good front-back 3D

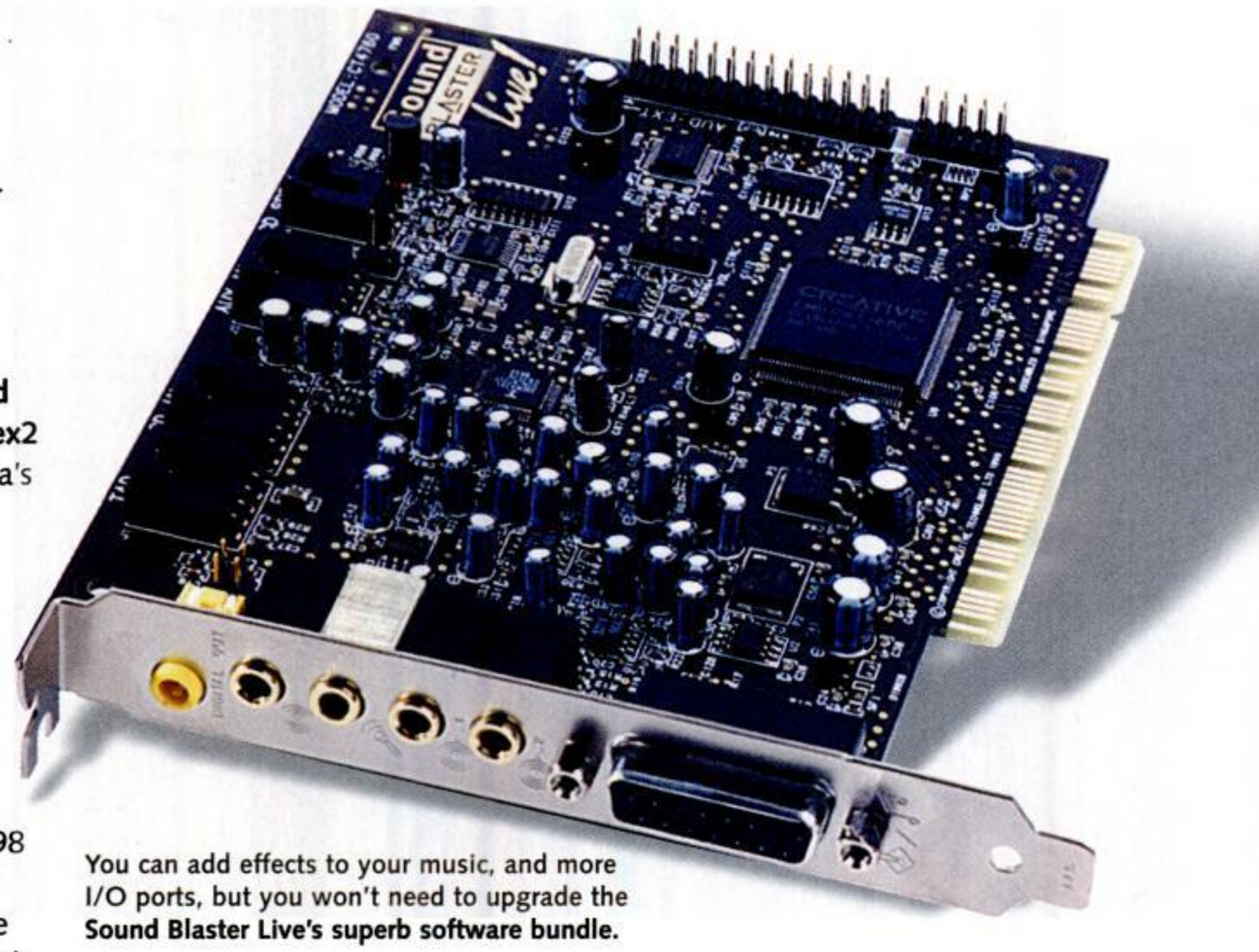
MP3+
- Strong software
- Expandable

MINUSES

SQ2500
- Lowest frame rates
- No MP3 encoder

MX400
- Pops on power-up
- Weakest software

MP3+
- Complex mixer
- Jumpy 3D sound



You can add effects to your music, and more I/O ports, but you won't need to upgrade the **Sound Blaster Live's superb software bundle.**

Creative Labs jumped into the 3D audio fray with its original Sound Blaster Live! card, which used the company's EMU10K1 chip to add four-speaker EAX reverberation effects to computer sound. It won a 10/Kick Ass verdict in our October 1998 issue. With the Sound Blaster Live! MP3+, Creative hasn't changed the technology one iota, but has instead repackaged the card with a smorgasboard of audio software. The MP3+ is physically identical to Creative's top offering, the $199 Sound Blaster Live! Platinum, and lacks only the Platinum's Live!Drive I/O expansion bay. This can be bought separately in $129 (electrical) and $149 (optical) configurations. Creative also offers a new auxiliary digital I/O card, making the MP3+ the most expandable card in this roundup.

As the name suggests, the MP3+ is all about music. The software bundle includes a music player, a recorder, and a complex mixer that can position an input source anywhere within a circle around you, and then apply EAX effects to it. An enhanced version of *MusicMatch Jukebox* lets you rip tracks from CDs and encode them to MP3 at rates of up to 320kbs. With some tweaking you can apply EAX effects to an MP3 file (or to any audio source) and save it as a new recording. Other highlights include *Cakewalk Express Gold,* a capable MIDI sequencer and multitrack audio recorder, and *Sound Forge XP,* a superb audio editor. Creative's deep software bundle trounces the other cards' offerings, but having to deal with four interrelated programs was confusing. The MP3+ is also the only soundcard here that doesn't include a standard S/PDIF jack for Dolby Digital 5.1 sound. You'll need the add-on I/O board mentioned above.

The MX400 is a good card for the money, and the best at front and rear positioning.

Aureal has taken a different approach to 3D with its Vortex2 SQ2500 card. Instead of simply slathering reverb onto sounds like the Sound Blaster, Aureal's A3D 2.0 technology reads a game's terrain information and uses geometry-based **wavetracing** to calculate the trajectories of sound reflections. Aureal also boasts that the SQ2500's Vortex2 chip contains 50 percent more transistors than the EMU10K1.

With the SQ2500, you get an RCA-format S/PDIF jack for direct connection to a Dolby Digital decoder, although for some reason a software DVD player isn't included. A basic music player with a 10-band EQ *is* included, as is a nifty little proggie called *Future Beat 3D,* a recording program that lets you mix together WAV files and position them in 3D space. Audio- and MIDI-editing programs are included as well, with full versions of the games *Drakan* and *Heretic II* and a limited version of *Slave Zero* rounding out the package. The SQ2500 is the only card here that doesn't include MP3 encoding software, which is disappointing. And with the exception of *Drakan,* the gaming bundle sucks. Still, we found the Vortex Control Panel to be the most intuitive of the bunch, and the Aureal card the easiest in the group to simply plug in and use. We appreciated the straightforward nature of its operation.

Diamond Multimedia's Monster Sound MX400 is powered by an ESS Canyon3D chip, which uses 3D technology from the highly regarded British developer Sensaura. Diamond claims Sensaura's four-speaker HRTFs generate a more convincing 3D effect

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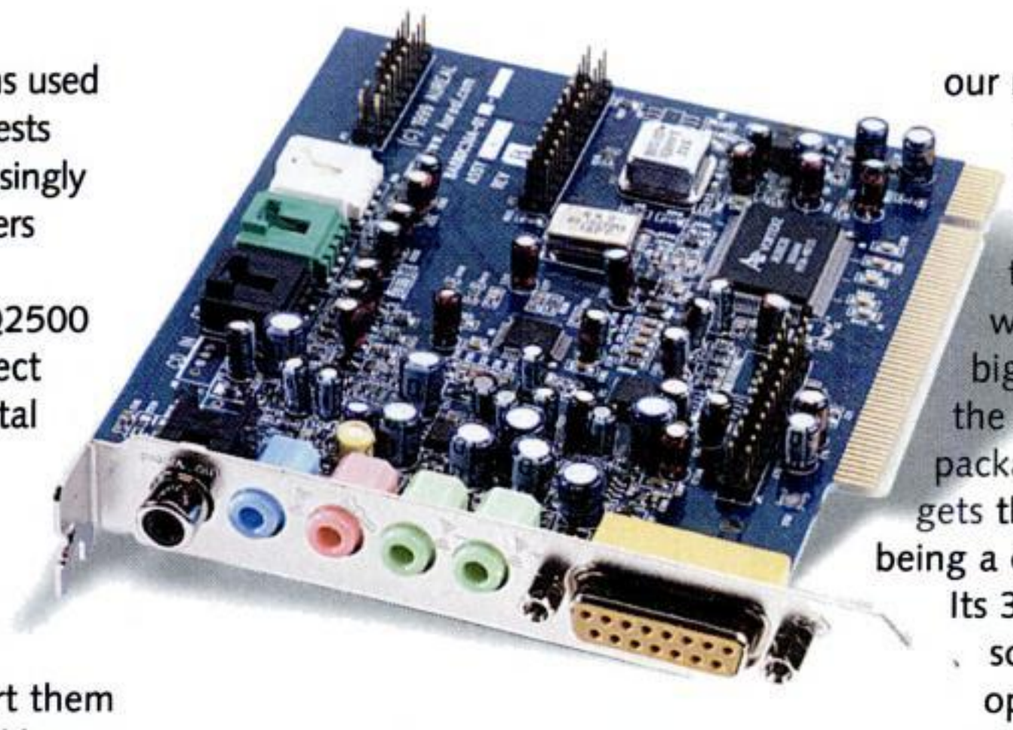
than the two-speaker versions used by EAX and A3D. Listening tests proved this claim to be surprisingly true. The Canyon3D also offers EAX emulation.

Like the MX400, the SQ2500 offers a S/PDIF jack for direct connection to a Dolby Digital decoder, but unlike Aureal, Diamond includes a soft DVD player. Diamond also threw in a copy of *RioPort Audio Manager,* which can rip tracks from CDs, convert them to MP3s at rates up to 256kbps, and organize the files. Wanna-be DJs will enjoy the copy of *Mixman Studio FX* (although you get the full version with Creative's card). And for people who enjoy lame games, trial versions of *Demolition Racer* and *Slave Zero* are included as well.

To determine real-world performance, we listened to each card on a Cambridge Soundworks DeskTop Theater 5.1 speaker system in quad mode. We repeated all tests in two-speaker mode as well as with a set of Sony MDR-V6 headphones, adjusting software settings as necessary. (Each card provides different 3D algorithms for each setup.)

Evaluating 3D audio quality is a highly subjective process, because the algorithms are designed to trick your ears into hearing objects that aren't there. Still, some clear impressions emerged. The MP3+ was the crudest of the bunch, with left-right and circular movements lurching between speakers rather than flowing smoothly, though



Aureal's SQ2500 provided the smoothest 3D and the least hassle.

the action was a bit better on headphones. The card's reverb effect in games was exciting, though somewhat over-the-top and not always realistic.

Unlike the Sound Blaster, the SQ2500 had extremely believable left-right positioning in both four-speaker and headphone modes. Front-back performance was better, too. And the SQ2500 had the best vertical positioning of the bunch, though that's not saying much. When compared to the other technologies, A3D 2.0 is very realistic, although true reverb won't arrive until the 3.0 version of Aureal's A3D technology surfaces, which should occur very soon.

In four-speaker mode, the MX400 was the best of all the cards at projecting a sound in front of the listener. It also has extraordinary rear placement, making sounds emanating from our rear (not those kind) very realistic. Gaming benchmarks proved the MX400 and Sound Blaster to be approximately equal, with the SQ2500 taking the biggest hit on frame rates in the group. As a complete package, the Sound Blaster gets the nod, by a hair, for being a complete sound solution. Its 3D isn't the best, but its software and upgrade options are unmatched in this group. The other cards are basically a draw. If you want the best 3D, go with the Aureal card, but if you're dying for MP3 and DVD software, the Monster sound is a steal for only $80.

—David Battino

VORTEX2 SQ2500 — 8

$100 | Aureal | 510.252.4245
www.aureal.com
RS Connect with this product at readershop.com/mpc0417
877.751.7467 ID#0417

DIAMOND MONSTER — 8

$80 | S3 | 541.967.2450
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SOUND BLASTER LIVE! — 9

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DARE TO COMPARE

MANUFACTURER	AUREAL	DIAMOND	CREATIVE LABS
Model	SQ2500	Monster Sound MX400	Sound Blaster Live MP3+
Hardware 3D	A3D 2.0, DS3D	Sensaura, DS3D	EAX 2.0, DS3D
Software 3D		A3D 1.0, EAX 2.0, I3DL2	A3D 1.0, I3DL2
Inputs	Line, mic, CD (analog), TAD, aux	Line, mic, CD (analog), TAD, PC speaker	Line, mic, CD (analog & S/PDIF), TAD, PC speaker, aux
Audio Streams	92	64	64
Proprietary 3D Streams	16 plus 60 reflections	48	32

BENCHMARKS FRAME RATES IN FPS	AUREAL VORTEX2 SQ2500	DIAMOND MX400	CREATIVE LABS MP3+
Quake III Arena (default settings)	48.1	47.5	**48.6**
Quake III Arena HQ settings (800x600, 32-bit)	35.7	**37.6**	37.5
Unreal Tournament 1024x768	16.07	**21.03**	21.01

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19-Inch Monitor Melee

ONLY ONE DISPLAY SHALL LEAVE VICTORIOUS

We won't kid you: We're suckers for the superior brightness and screen consistency that aperture grille monitors offer. That stated, picking the **NEC FP950** as the winner of this 19-inch round-up was a no-brainer. When sandwiched between the **EIZO FX-D7** and **Viewsonic E790** in side-by-side testing, the NEC clearly offered a more spectacular, richer image than its shadow-mask competitors.

The NEC boasts a variable grille pitch of 0.25mm to 0.27mm, and hits a 73Hz refresh rate at its maximum resolution of 1920x1440. At its most sensible resolution of 1280x1024, the monitor can hit a whopping 102Hz. But what makes the NEC really special is its perfectly flat screen—no bulbous fishbowl effect, Elroy! The screen flatness is certainly pleasing to the eye (in that it displays naturally flat images on a naturally flat surface), but also introduces slight geometric distortion in the extreme corners of the display. During *DisplayMate* testing, we found that perfect circles became slightly oblong ovals.

All flat-screen monitors suffer this type of corner distortion, and the NEC's corner performance is no worse than what you'll find in Sony and Mitsubishi displays. The NEC passed the rest of *DisplayMate*'s obstacle course with great performance. Compared to its competitors, it displayed the blackest blacks, and its whites were whiter than an Osmond family Christmas special. Screen purity was superb—none of that ugly mottling that makes shadow-mask monitors look like they've been sprayed by a fine mist of espresso grounds. In fact, if you throw out corner accuracy, the NEC beat the other two monitors in every obstacle course test—except fine-text reproduction, where the EIZO was a smidgen less fuzzy.

PLUSES

NEC FP950
- Flat-screen
- superior brightness and screen consistency
- accurate blacks and whites

EIZO FX-D7
- Good text repro
- Good corner geometry
- USB hub

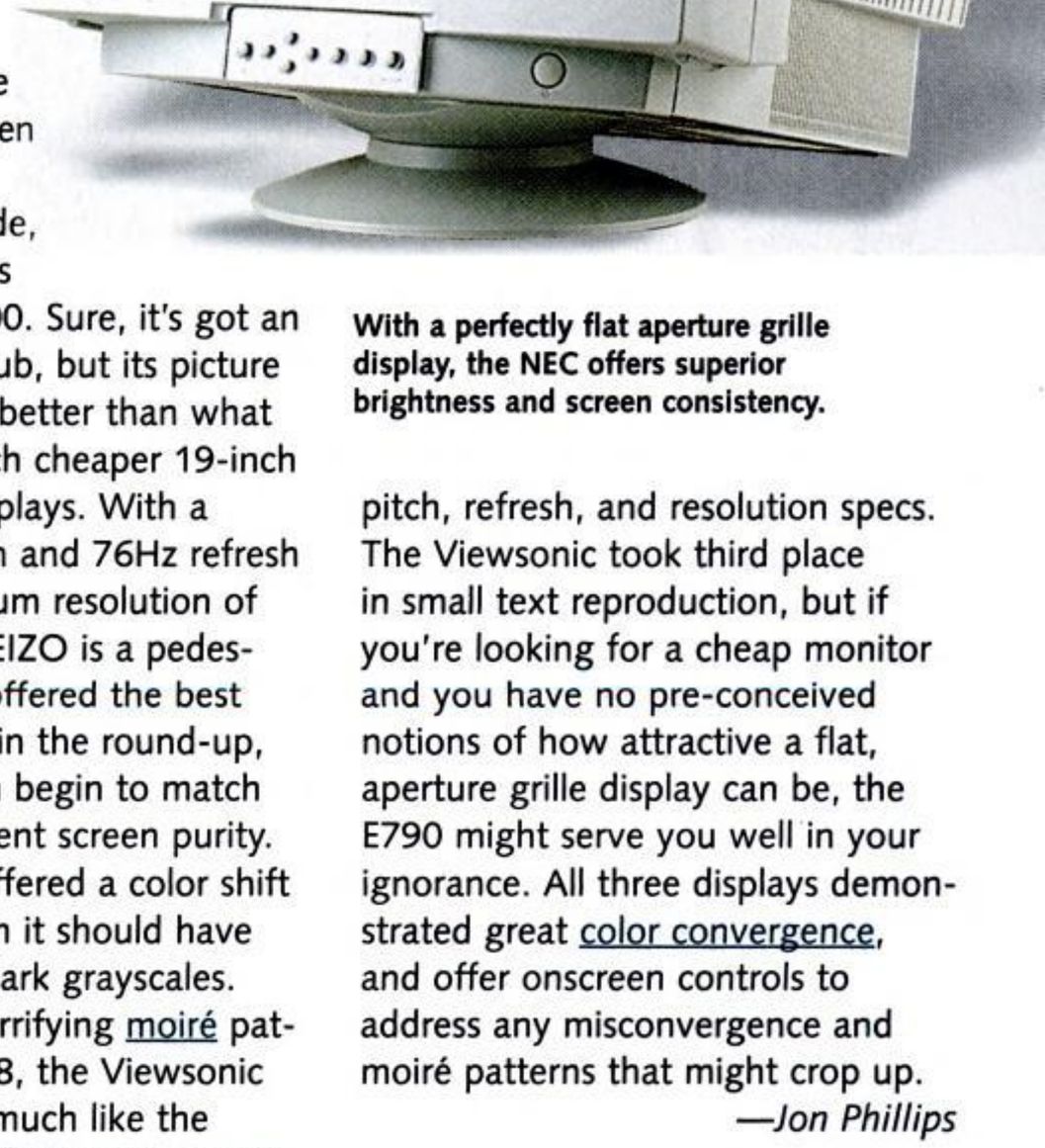
VIEWSONIC E790
- Inexpensive

MINUSES

NEC FP950
- Geometric distortion in corners

EIZO FX-D7
- Overpriced
- Blue color shift
- Mottled screen

VIEWSONIC E790
- Moiré issues
- Mottled screen



With a perfectly flat aperture grille display, the NEC offers superior brightness and screen consistency.

EIZO: unspectacular and expensive.

Text repro aside, the EIZO FX-D7 is overpriced at $700. Sure, it's got an integrated USB hub, but its picture doesn't look any better than what you'll see on much cheaper 19-inch shadow-mask displays. With a 0.26mm dot pitch and 76Hz refresh rate at its maximum resolution of 1600x1200, the EIZO is a pedestrian monitor. It offered the best corner geometry in the round-up, but couldn't even begin to match the NEC's consistent screen purity. The EIZO also suffered a color shift toward blue when it should have been displaying dark grayscales.

Aside from horrifying moiré patterns at 1024x768, the Viewsonic E790 performed much like the EIZO—same mottled screen purity, same level of brightness and overall vibrancy. But the Viewsonic also costs about $300 less than the EIZO, and offers the same dot pitch, refresh, and resolution specs. The Viewsonic took third place in small text reproduction, but if you're looking for a cheap monitor and you have no pre-conceived notions of how attractive a flat, aperture grille display can be, the E790 might serve you well in your ignorance. All three displays demonstrated great color convergence, and offer onscreen controls to address any misconvergence and moiré patterns that might crop up.

—Jon Phillips

Viewsonic: unspectacular but cheap.

NEC FP950 — **8**

$650 | NEC | 877.484.5536
www.nectech.com
Connect with this product at readershop.com/mpc0419
877-751-7467 ID#0419

EIZO FX-D7 — **5**

$700 | EIZO | 800.800.5202
www.eizo.com
Connect with this product at readershop.com/mpc0420
877-751-7467 ID#0420

VIEWSONIC E790 — **6**

$379 | Viewsonic | 800.888.8583 | www.viewsonic.com
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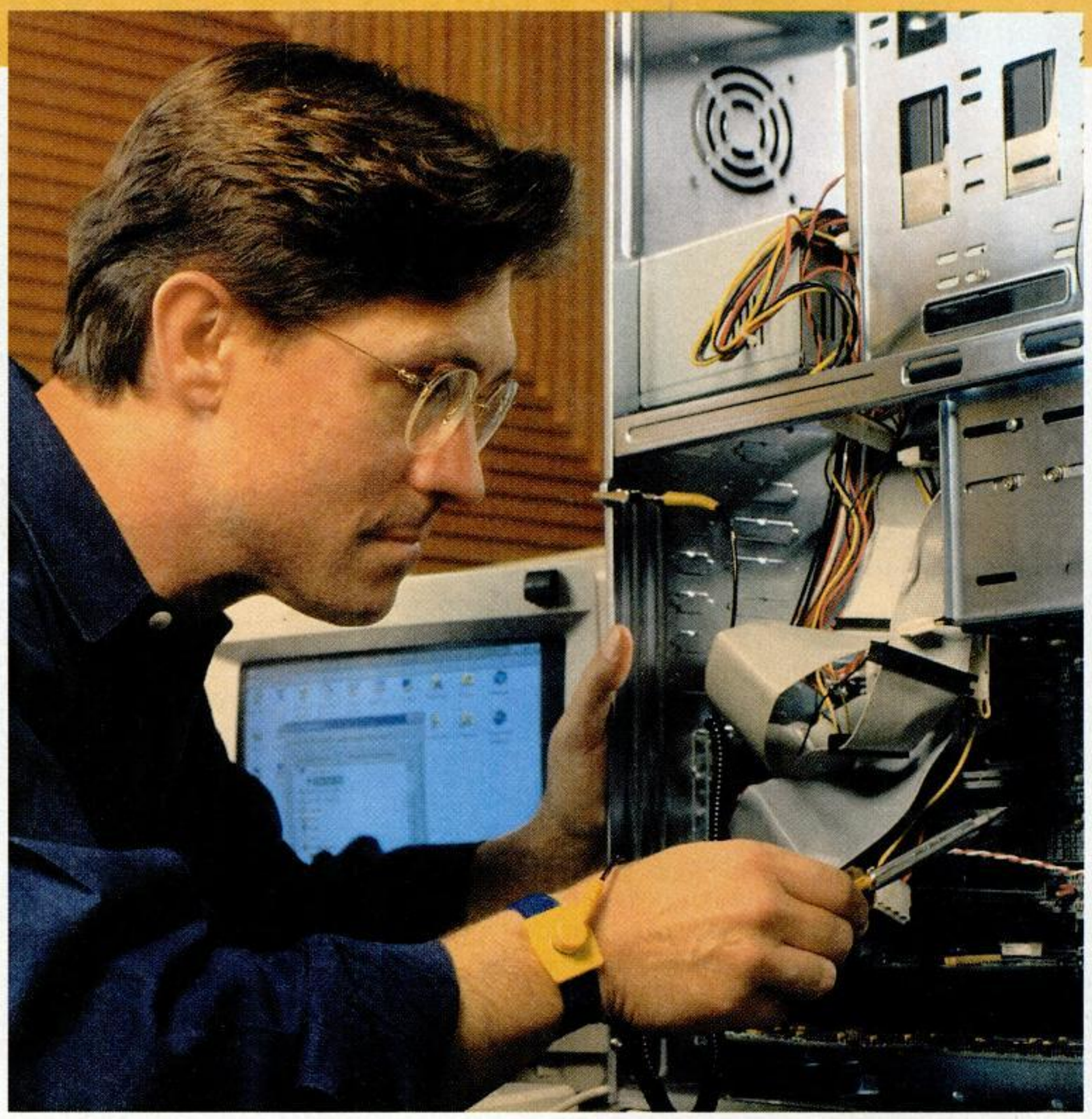

Important Facts About a Career in Computers:

- Over 400,000 jobs are expected to open in the computer field by the year 2005.
- Computer careers are among the highest-paying in the nation, with experienced programmers earning as much as $60,000 a year and more.
- Harcourt Learning Direct can prepare you for an exciting career in computers in as little as three months!

Train at home in your spare time for a career with a future! Learn at your own pace, without rearranging your schedule. And you need no previous experience — just ambition and the desire to succeed.

Here are just a few of the fast-growing computer careers you can choose from:

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- Do PC upgrades, network installations, and more.
- Start your own business — choose your own hours.
- Professional-quality tools and A+® Certification Test Preparation included.

Computer Graphic Artist

- Design newsletters, brochures, and ads.
- Construct 3D drawings, edit digital photos, prepare a great portfolio.
- CorelDRAW!™ included with your program at no extra cost.

Web Page Designer

- Master HTML and make your mark on the Web.
- Work for an established Web design firm or start one of your own.
- Program features Microsoft® FrontPage™ '97 and Earthlink Internet Access Software with Netscape® Navigator™.

Java®

- Bring the World Wide Web to life with eye-catching animations.
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Axis Terra AXD Athlon 800

THIS AXIS IS SKEWED

You can dress it up, but the Terra AXD is still a plain Jane.

PLUSES
- DDR GeForce
- 34GB hard drive
- A potentially great home theater setup

MINUSES
- DVD-ROM broke
- Glitches galore
- Average performance

Last month's $1,500 machine from Axis Systems was pretty stacked in light of its low price, so we invited Axis to send us another box with no holds barred. The result is the Terra AXD, an Athlon box filled with almost every component on our lust list. It's got a 10x Pioneer DVD-ROM, Sony 8x CD-RW, Real Magic Hollywood Plus card, SoundBlaster Live! Platinum, 256MB of SDRAM, and of course, an 800MHz Athlon. On paper, it's da bomb—but in our Lab, the Terra AXD *became* a bomb, plagued by mysterious system crashes, blue screens of death, and a DVD-ROM drive that quit functioning after running our *SYSmark* benchmark.

Testing started out fine, with scores rolling in that were more or less status quo. We kept hoping that we'd see a breakthrough somewhere, but alas, it was not meant to be. In each of our eight benchmarks, the Axis system performed impressively, but didn't break a single record.

In CPU and chipset tests, the Terra AXD posted scores similar to those of the Athlon 800 from Polywell, though that system's RAID array helped it push out bigger scores across the board. The Axis also fared well in gaming tests, but its most impressive performance was in *Photoshop*, where it missed the Polywell's record score by one lousy second. Unfortunately, this system's motto is "close but no cigar."

The Axis system's worst score was certainly CD-Tach; we never got it to run, thanks to a DVD-ROM drive that was problematic from the get-go. The drive also failed to play DVD movies, putting a damper on our favorite part of benchmarking—watching flicks. Turns out the drive was toast, so before long, any disc so we put in it gave us the BSOD, so we turned the lights back on and finished testing.

In light of those and a slew of other glitches, we wonder if Axis should have run this system by an exorcist before it was shipped. The machine would hang on startup, occasionally shut off completely, and sometimes freaked out when we installed benchmarking applications (which we had to do through the CD-RW, mind you), forcing us to perform a cold boot and continue.

Another bone we have to pick is that there's nothing truly compelling about the system, nothing that jumped out and grabbed us. For example, last month's Kick Ass Dell had a 64MB DDR GeForce, and the Polywell in this issue has striped hard drives and a custom silver paint-job, but the Axis is plain vanilla all the way. Its performance fell into the same category, delivering scores equal with our expectations, but not above.

The bottom line here is that other systems we've tested outperform the Axis, and the Polywell has better features for roughly the same price. This system has all the right components, and if it had performed flawlessly, it would easily have won a Kick Ass. But considering the glitches we encountered and average benchmark scores, we're afraid this is one stacked machine that's shockingly mediocre.

—Geoffrey Visgilio

UNDER THE HOOD

THE BRAINS

CPU	Athlon 800MHz
L2 Cache	512k discreet
RAM	256MB PC100 SDRAM (1024MB max)
Motherboard	Microstar 6195, AMD 750 chipset
Drive Bays	Three 5.25-inch, three 3.5-inch (one free)
I/O ports	Two USB, two serial, one parallel, PS/2, gameport, TV-out, VGA-in, VGA-out, S/PDIF-in, S/PDIF-out, MIDI-in, MIDI-out, two line-in, two line-out, headphone-out

DISPLAY

Video	Creative Labs Annihilator Pro 32MB DDR SDRAM
Monitor	Pro
Res/Refresh	Refresh@max res: 100Hz@1600x1280

STORAGE

Hard Drive	34GB IBM Deskstar, ATA/66, 7200rpm
CD/DVD	10x Pioneer 104S
CD-RW	8x/4x/32x Sony CD-RW CRX14OE
Removable	Floppy

SOUND

Sound	Creative Labs SoundBlaster Live! Platinum
Speakers	Cambridge Soundworks Desktop Theater 5.1 DTT2500 with Dolby Digital surround and subwoofer

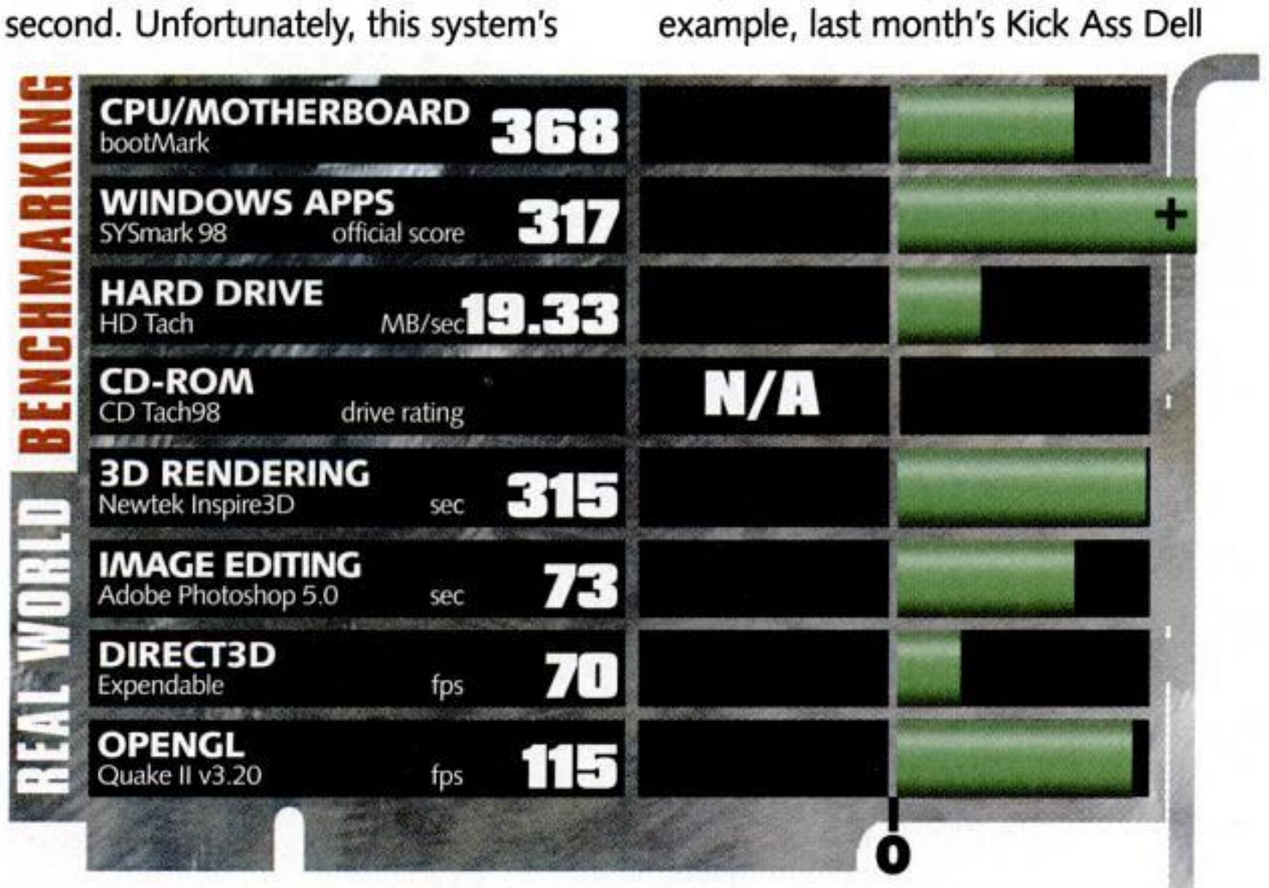
OTHERS

3Com 905TX PCI Fast Etherlink Network Card
Sigma Designs Real Magic Hollywood Plus

THE BUNDLE

Microsoft *Works 2000 Suite*

BOOT 1:33 DOWN 0:04



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EXPANSION NOTES

The Axis has only one PCI slot and two ISA slots free for expansion, but there ain't much left to put inside.

EXPANSION MAP

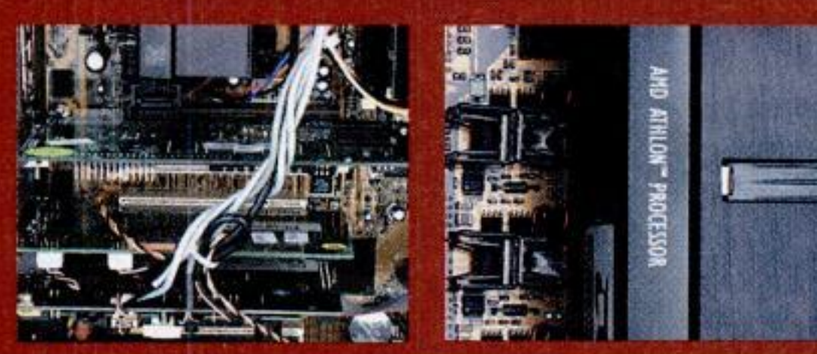
- **AGP** Graphics card
- **PCI** Real Magic MPEG2 Decoder
- **PCI** NIC card
- **PCI** Modem
- **PCI** Soundcard
- **PCI** Free
- **ISA** Free
- **ISA** Free

IROS

00 System Timer	**07** Printer (LPT1)
01 keyboard	**08** System Clock
02 Interrupt Controller	**09** SB16 Emulation
03 IRQ Holder	**10** IRQ Holder/MPEG Card
03 PCI to USB Host	**11** IRQ Holder
04 COM 1	**12** PS/2 Mouse
05 SB Live!	**13** Num Data Proc
05 IRQ Holder	**14** IDE Controller
05 GeForce	**15** Secondary IDE Controller
06 Floppy	

DMAS

02 Floppy	**04** DMA Controller
03 SB16 Emulation	**07** SB16 Emulation



DVD playback, the hard way Axis popped in a Hollywood Magic card and included 5.1 speakers that would have left us spent and craving a cigarette if the damned DVD drive worked.

800 horses under the hood AMD is still using slow-ass 2/5 core speed cache with its 800MHz proc. This one cranked out respectable scores, but ran hot enough to make us worry.

Audiophiles come hither Screw that reach-around-the-back stuff. The SoundBlaster Live! Platinum has MIDI and S/PDIF hookups right up front where we like them.

Just slip it in, baby No more fumbling with the tray in the dark, trying to get it open, and get the disc in before you lose that "feeling."

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Interstate 82

PUT YOUR ROAD RAGE TO GOOD USE

If you've ever dreamed of donning a pastel linen suit, strapping automatic weaponry to the roof of your car, and opening fire on other motorists while cruising America's highways and by-ways—and who hasn't?—*Interstate 82* will be right up your alley. But if you're looking for a sophisticated, polished driving game that's better than its predecessor, you'll be sorely disappointed.

THE SPECS

3D CARD SUPPORT
Direct 3D

3D SOUND SUPPORT
Direct Sound

MULTIPLAYER
TCP/IP, LAN, Internet

TOTAL PLAYERS
Internet: 4
LAN: 6

PLUSES
- Cars and guns, woohoo!
- Awesome multiplayer
- Capture the Trout, baby!

MINUSES
- Graphics are so-so
- Enemy AI is buggy
- Storyline is horrifically cheesy

I82 is the follow-up to *Interstate '76*, a sick-and-twisted driving game that followed the tried-and-true "Miami Vice" formula of combining bad acting with driving. What's new in the sequel? The option to exit your vehicle, perform a carjacking, and shoot other drivers in the head with your .45 handgun, and a roster of 80s-replica vehicles you can drive around in. The weaponry has also been upgraded to a level best described as ridiculous; the radio-controlled death-ray that fires from an orbiting satellite provides an excellent example of what we mean when we say *I82* is truly over-the-top.

Graphics are handled by the Darkside engine (á la *Heavy Gear II*), which brings the game's carnage to life in full 32-bit color, though the puny 128x128-bit textures are strictly old school as far as 3D specifications go. Luckily, an awesome physics engine compensates for the middling graphics engine, providing a perfect combination of realism and fun. You can use your emergency break to pull 180-degree spin-outs, or watch oil slicks and changing road conditions spin your car out of control faster than you can say GEICO.

This guy cut us off, so we blew his car to the great parking lot in the sky.

***Interstate 82*'s weaponry includes auto-tracking, and roof-mounted rocket launchers. Say goodnight, Gracie.**

Alas, as is the case with just about every driving game available today, *I82* is full of clipping problems, twitchy enemy AI, and erratic steering control. The clipping issue is especially bad for enemy vehicles, which sometime emerge from the middle of walls, bridges, and buildings, and often get stuck in corners. The AI is also hit-and-miss—some enemies are so stupid you can box them into corners, while others are as hard to shake as the Terminator and are just as deadly.

As you might expect, gameplay takes a backseat to wackiness and innovation in this shooter, making the game enjoyable but about as deep as a urinal. All we wanted to do was drive around and shoot stuff without being interrupted by such distractions as "level goals" and FMV cut scenes, so we played the single player game for awhile, but decided it was too buggy and boring to be worth our time.

On the other hand, multiplayer completely kicked our tailpipes, with action that's fast, funny, and highly illegal. The vehicle choices alone are worth a chuckle, ranging from huge tankers and school buses to a teeny golf cart called the "Greens Queen." Multiplayer game options include a kill frenzy in which you try to be the last one standing; a hot potato round in which you pass off a time bomb by ramming other cars, until one unlucky sap gets the goods; and our personal favorite, Capture the Trout. It's like Capture the Flag, but with a giant trout that you strap to the roof of your car.

After suffering in January through the tour de farce called *Driver*, we had pinned our hopes for a good driving sim on *I82*. Though its high-powered weaponry and Capture the Trout multiplayer provide middling entertainment, *I82* is decidedly worse than its predecessor and falls very short of our high expectations.

—Geoffrey Visgilio

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Final Fantasy VIII

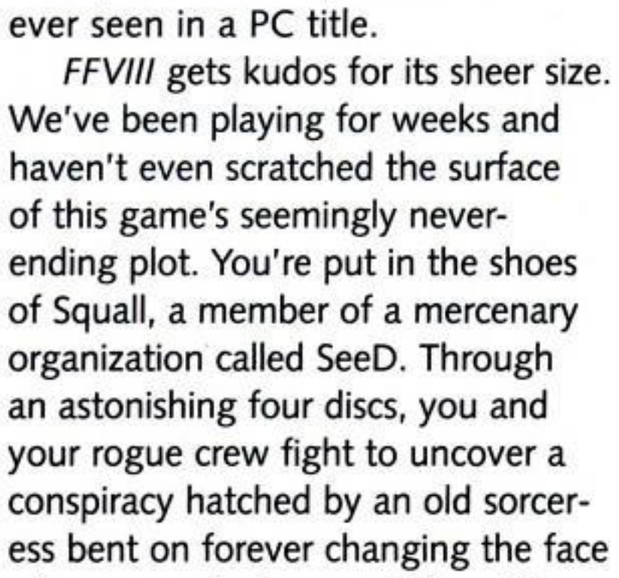
GIVE YOUR SOCIAL LIFE A LONG KISS GOODNIGHT

The latest addition to the *Final Fantasy* series is, like its predecessors, a full-time occupation. You'll lose your job, your girlfriend will leave you, and you'll forget to bathe. After playing this game for days, you'll be dirty, smelly, and probably loopy from sleep deprivation. But the one thing you won't be is disappointed, because *Final Fantasy VIII* rocks.

The *Final Fantasy* series is among the most successful in the fantasy/RPG genre, and the eighth installment brings a lot of new material to the table. Rather than picking up where the last game ended, *FFVIII* offers a whole new storyline, entirely new fighting and magic systems, and even a mini-game you can play on your desktop. We haven't touched the mini-game junk, but we love the new emphasis on Guardian Forces (summoning power, for *FFVII* veterans), and the pre-rendered cut scenes are, hands down, the most impressive we've ever seen in a PC title.

FFVIII gets kudos for its sheer size. We've been playing for weeks and haven't even scratched the surface of this game's seemingly never-ending plot. You're put in the shoes of Squall, a member of a mercenary organization called SeeD. Through an astonishing four discs, you and your rogue crew fight to uncover a conspiracy hatched by an old sorceress bent on forever changing the face of your seemingly peaceful world.

For *FFVII* veterans, gameplay will take some getting used to; the new magical power system is based on



Come on, you remember how to fight, don't you? Attack, summon, cure.

***Final Fantasy VIII* has phenomenal FMV sequences.**

combining your own power with that of your Guardian Forces through a junction system. The GFs travel with you and become more powerful alongside you through battle. Eventually, you can combine their abilities with your own, for more powerful spells that can be used in combat. At first, we missed the old "let my character be John Rambo and do all the work" style, because we knew exactly how to exploit it. But in the end, we enjoyed the teamwork aspect. It took us some time to figure out the right combinations, but once we discovered them, we began laying waste to opponents left and right.

The practice of gathering magic points to increase a spell's power has been replaced in *FFVIII* by a system through which you draw magical power from enemies during combat. We loved robbing foes of their power, and as your magical levels progress, you can cast more powerful spells, and even take special Guardian Forces from enemies. There is no armor upgrading, only weapons modifications that require you to have the right parts and find a shopkeeper willing to tinker with your weapon. Gaining increased power does have a downside, though—some of the Guardian Forces and Limit Break attacks are very lengthy, and become boring to watch after about the fifth time.

Enough gushing; *FFVIII* does have a few problems. As hardcore gamers, we're a bit miffed that the game uses the same old cheesy sprite animation on pre-rendered backgrounds. The dreadful MIDI music also drove us absolutely crazy, though we've come to realize that it's part of the series' charm and that it adds anime flavor to the proceedings.

As a follow-up to one of the most successful games in history, *Final Fantasy VIII* is a real winner. Its redesigned gameplay takes some getting used to, but we found it to be much more intuitive than the model used in *FFVII*, and the overall experience exceeded our wildest expectations.

—Geoffrey Visgilio

PLUSES
- Epic storyline
- Amazing CGI sequences
- Lots of secrets and side quests

MINUSES
- Lengthy Limit Breaks and GF attacks
- Card game is complicated and annoying
- Some parts are boring

THE SPECS

3D CARD SUPPORT
Direct 3D

3D SOUND SUPPORT
Direct Sound

MULTIPLAYER
None

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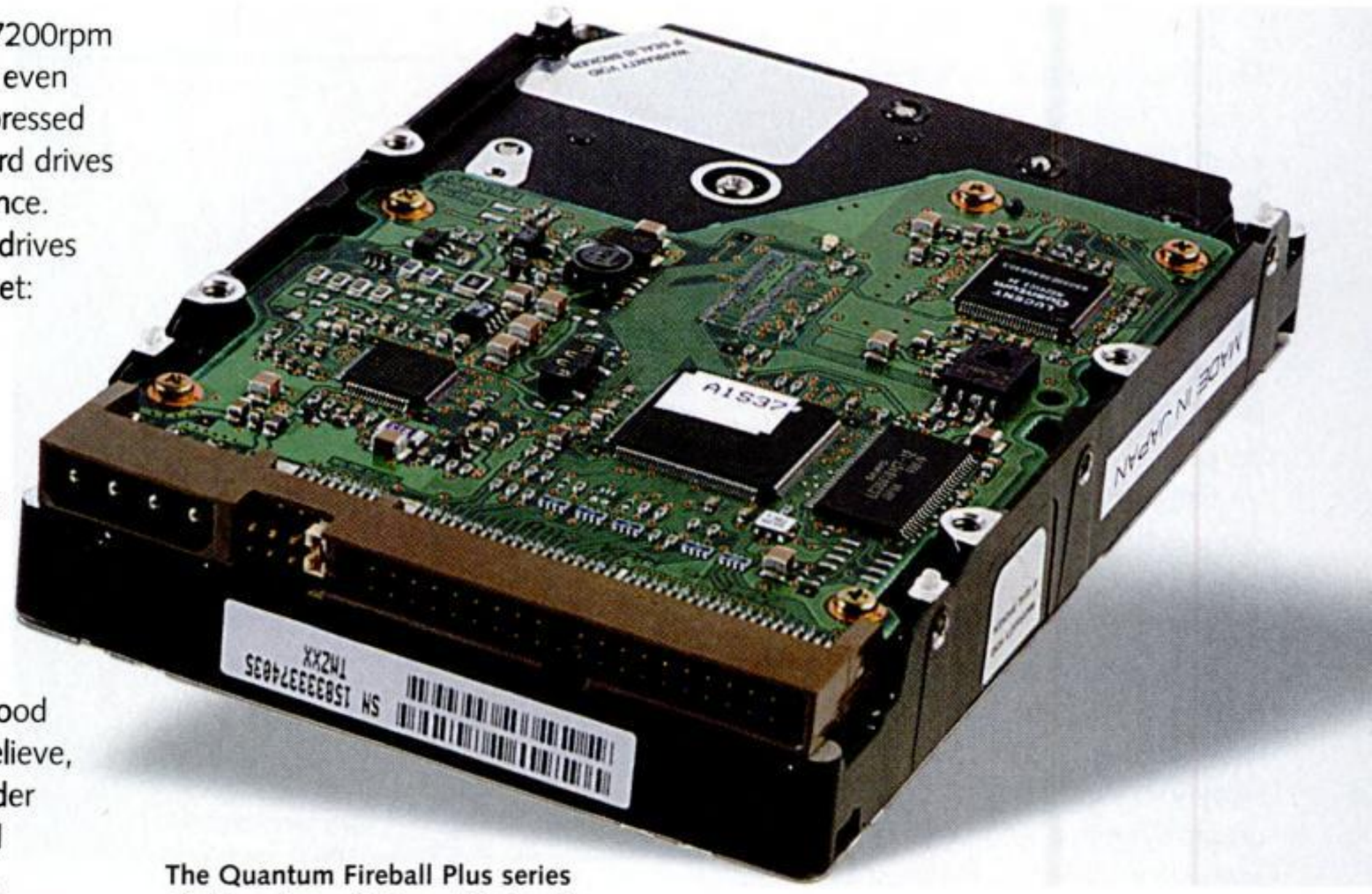
ATA Hard Drive Warfare

NEW TECHNOLOGY BREAKS SPEED, SIZE LIMITS

With spindle speeds pushing 7200rpm and capacities of up to 40GB, even SCSI fanatics would be hard-pressed to say that today's ATA/66 hard drives don't offer smoking performance. Currently, two generations of drives exist side-by-side on the market: 6.8GB per platter drives, and 10.2GB per platter drives. Needless to say, newer drives outperform those built with the older technology, but that doesn't mean an old dog can't fetch data like an energetic little puppy. We rounded up two new-school drives to see if they were as good as their marketing led us to believe, and pitted them against an older drive, to see how it performed against the spry young things.



The Quantum Fireball Plus series **of drives has a history of being the quickest on the market, and the KX drive comes close, despite using older technology.**

PLUSES

QUANTUM
- Blazing burst rates
- Best I/O scores

SEAGATE
- Whisper quiet
- Monster read speeds

MAXTOR
- Fast read/write speeds
- 40 friggin gigs
- Runs quiet and cool

MINUSES

QUANTUM
- Loud
- Slowish read speeds

SEAGATE
- Sluggish burst rates
- Runs hot

MAXTOR
- High access times

If you're new to the hard drive game, you might appreciate a primer on how drive generations are differentiated in order to better understand how a hard drive works and what to look for when throwing down your allowance (or paycheck) for that new multi-gigger. Hard drive performance involves two primary factors: the amount of data packed onto a single drive disc (or platter), and the speed at which the platter spins. A measurement called areal density, used primarily by engineers, determines how many bits of data are packed in a square inch of disc surface. Typically, areal density is expressed in megabits or gigabits per square inch (Gb/inch^2). Ultimately, this determines the amount of gigabytes (GB) that can be stored on both sides of a single drive disc. This number, multiplied by the total number of discs used in the drive, determines the full size of the drive. Manufacturers offer various drive sizes by building them with different numbers of discs.

With new innovations that improve reliability and performance, Seagate's Barracuda ATA II shows the company's determination to be a top performer in the ATA world.

The other factor, called spindle speed, remains a constant 7200rpm for high-end drives and 5400rpm for low-end drives. These rpm speeds affect sequential reads, which require data to be laid out in succession, so bits of data can be read one after another to take advantage of the high speeds. A drive's random access time is also important. It comes into play when data is fragmented or when smaller pieces of data are being requested. Other factors, such as interface (read) burst speed and CPU utilization, also play important roles in performance. We test each of these individually, and include transaction rate testing and Input/Output rate testing along with real-world benchmarking, to determine a drive's overall performance. Of course, innovations that ensure stability, reliability, and longevity can also affect a drive's capabilities, though the methods implemented to these ends vary from manufacturer to manufacturer.

The **Quantum Fireball Plus KX** is a member of the hard drive old guard, with an areal density of approximately 5Gb/in^2. Quantum has a history of building drives with lightning-fast random access times and high burst rates, and the Fireball Plus KX continues the tradition. While throughput scores weren't spectacular, the drive scored the highest I/O rate and random access scores in the Intel Iometer benchmark. If you're forced to rely on a non-SCSI drive in a server environment, this is the one to use.

The Fireball Plus KX's real-world benchmark scores were the best when compared to other older-generation drives from IBM and Fujitsu (neither of which made it into the roundup). The KX ran surprisingly cool, but gets the "Loudest Drive Award" due to the constant ratcheting-like noises it emits during reads. If you're concerned about this drive's last-gen status but you like Quantum drives as much as we do, watch for Quantum's newly announced LM series of drives, which feature an areal density on par with the others and include a fat 2MB buffer.

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

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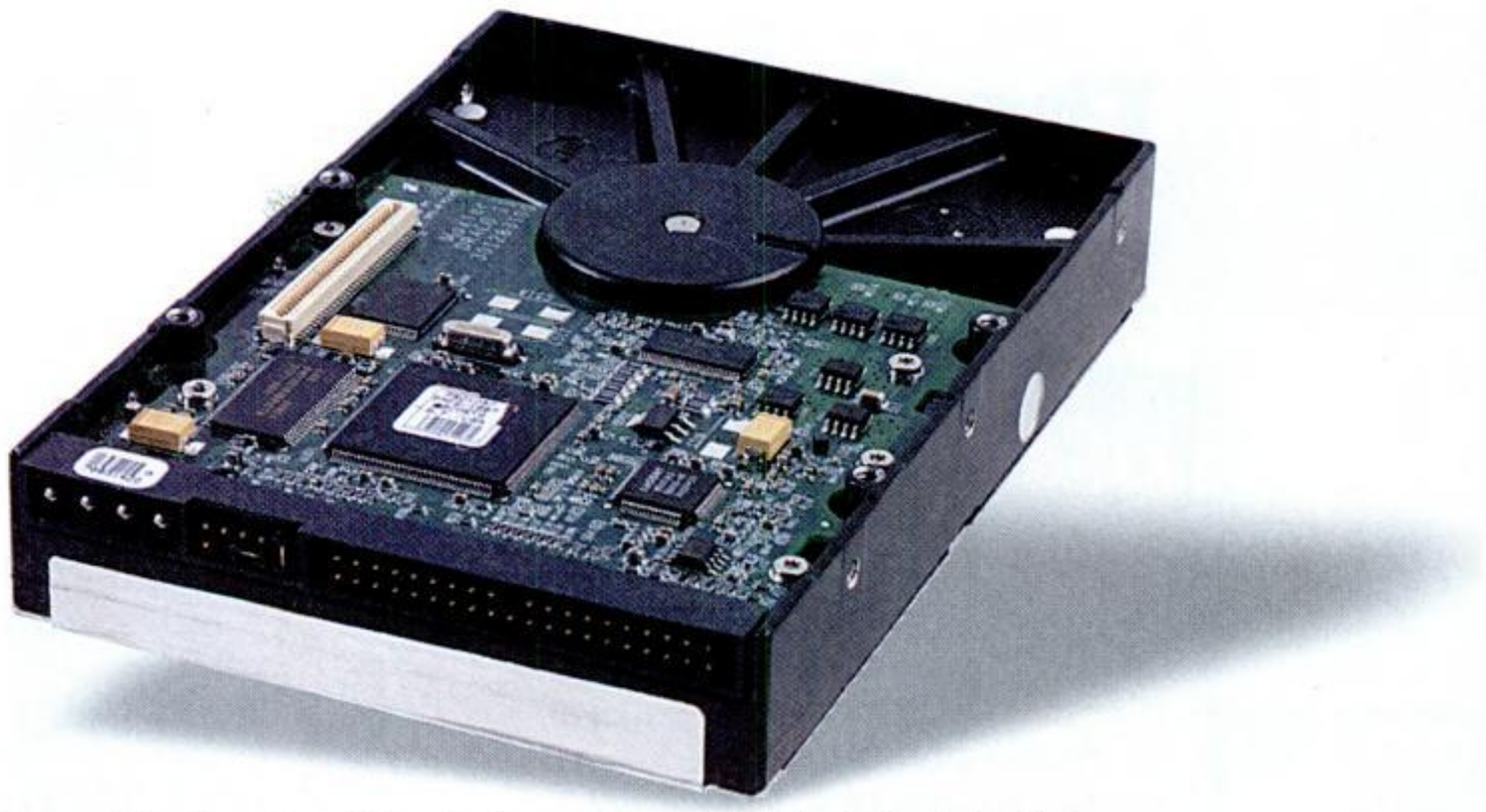

The DiamondMax Plus 40 combines dual-processing and the latest drive technologies to deliver the largest (40GB) and fastest ATA hard drive we've seen.

The drives from Seagate and Maxtor represent the next generation of ATA drive technology, packing areal densities of 7.3 to 7.6Gb/in^2 and containing platters that each hold 10.2GB of data.

Seagate has been known for making zippy drives since its first foray into the ATA realm, with the original Barracuda drive. The **Barracuda ATA II** raises the bar for the series, with better performance and some new technologies. Seagate quadrupled the buffer to 2MB and added a specialized fluid dynamic bearing motor (in the 30.6GB drive only) to help decrease acoustics and improve power. Seagate claims it's the world's quietest 7200rpm drive at just 3.4 bels and we agree, although it does run hot. We think the excessive heat is most likely due to the metal plate that covers the chips on the drive's underside. In real-world benchmarks, the ATA II outperforms the original ATA by 2-to-3MB/sec overall and improves on random access times by 2-to-3ms. Burst rates are still very low though, and the Iometer benchmarks were lower than expected. Neither of these affected real-world performance, and the Barracuda ATA II is indeed a contender for Kick Ass status. Seagate also claims the Barracuda ATA II is the world's toughest drive, with "best-in-class, non-operating shock absorption tolerance."

Usurping all other drives in this roundup in terms of size and performance is the **Maxtor DiamondMax Plus 40**. It packs a whopping 40GB on four discs, making it the largest ATA drive currently shipping. It includes Maxtor's proprietary DualWave controller, which combines a Texas Instruments DSP to control drive functions and a specially designed 50 MIPs RISC processor for handling host commands. All that stuff makes a difference, too; the drive delivered the highest throughput scores in the roundup. While random access times were also high, this was purely showing off, since the raw speed of the drive was enough to deliver the best real-world benchmark scores we've ever recorded. Also included is Maxtor's MaxSafe technology, which combines background surface scans, advanced ECC error checking, and high-fly write detection that detects head position for improve data reliability. The icing on the cake is the minimal heat and noise generated by the DiamondMax during operation. This is a drive that truly combines massive storage capacity with superior performance in a package that lets you have your cake and eat it too.

—Sean Cleveland

DARE TO COMPARE

MANUFACTURER	QUANTUM FIREBALL PLUS KX		SEAGATE BARRACUDA ATA II		MAXTOR DIAMONDMAX PLUS 4.0	
Drive Size	27.3GB		30.6GB		40GB	
Buffer Size	512KB		2MB		2MB	
Operating System Tested On	Win98	WinNT	Win98	WinNT	Win98	WinNT
HD TACH BENCHMARKS						
Average Read Speed (MB/sec)	19.3	19.3	**24.6**	**24.6**	24.4	24.4
Average Write Speed (MB/sec)	14.8	14.8	16.3	16.2	**17.3**	**17.6**
Random Access Time (ms)	**11.7**	**11.8**	13.2	13.1	14.3	14.7
Read Burst Speed (MB/sec)	**58.9**	**58.1**	48.2	48.6	56.8	56.3
CPU Utilization (%)	4.5	1.9	4.5	2.6	**3.3**	2.7
INTEL IOMETER						
Max. Read Speed (MB/sec)	n/a	22.2	n/a	28.3	n/a	**28.9**
Max Read I/O Rate (I/Ops)	n/a	**12,776**	n/a	7,166	n/a	10,643
Random Access Test (tps)	n/a	**83.2**	n/a	78.7	n/a	69.3
REAL WORLD BENCHMARKS						
Time to boot OS (seconds)	18.8	21.6	18.1	**20.3**	**18.0**	23.5
Time to copy 644MB (min:sec)	3:00	3:29	2:08	2:19	**1:34**	**1:25**

Note: Best scores are bolded

QUANTUM FIREBALL 8

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MAXTOR DIAMONDMAX 9

KICK ASS! product
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For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

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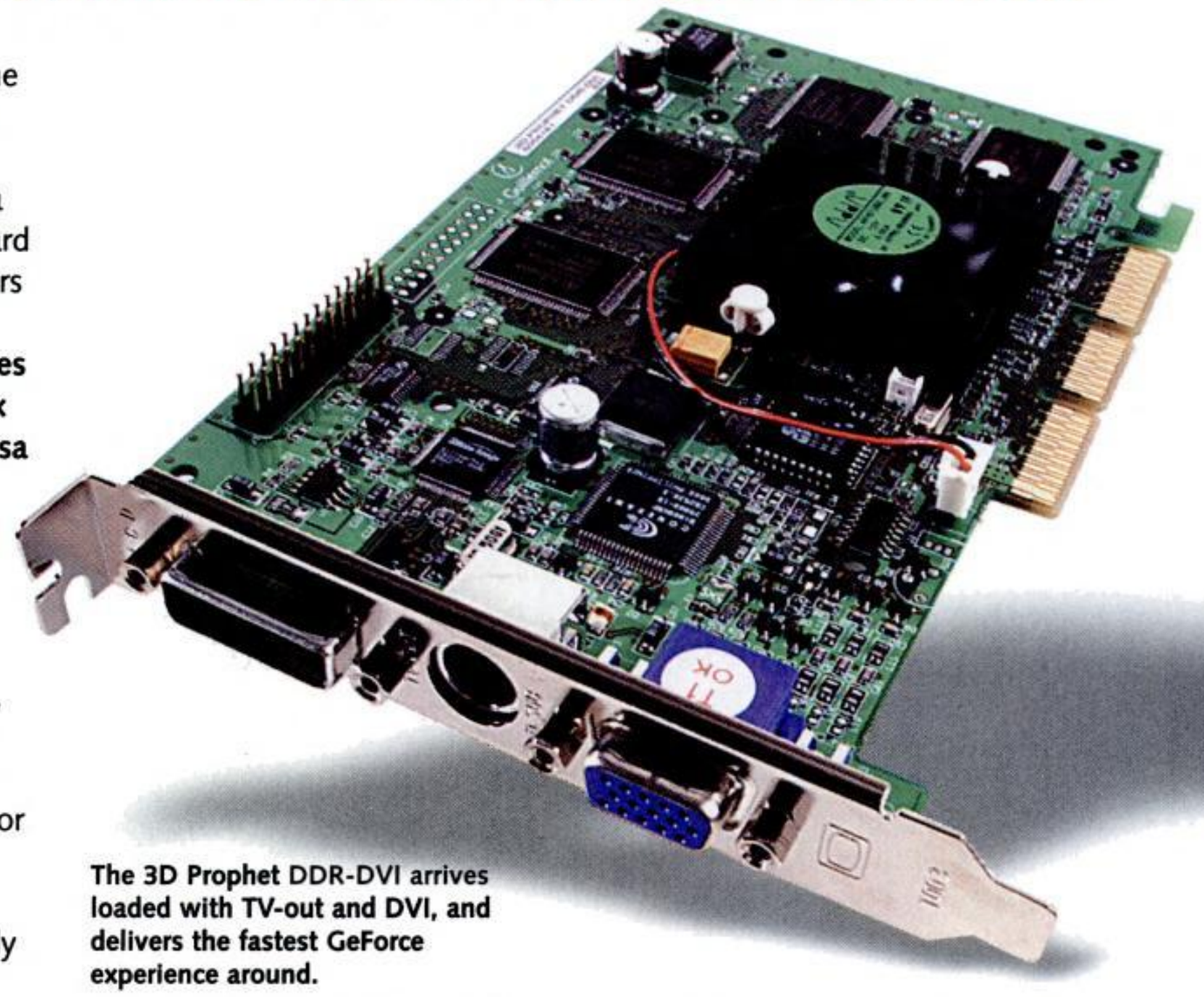
The GeForce DDR Gamble

THREE NEW VIDEOCARDS DOUBLE DOWN FOR A BIG PAYOFF

MAXIMUM PC KICK-ASS! product

The first card to mate the GeForce 256 with DDR memory was Creative Labs' Annihilator Pro, a feat that earned the card Gear of the Year honors last December. Now, three new videocards—the **Hercules 3D Prophet DDR-DVI**, the **Leadtek WinFast GeForce DDR**, and the **Elsa Erazor X²**—are all doing the DDR Do-si-do. Each delivers the same Kick-Ass performance and core features as the Annihilator Pro, but each is packaged a little differently. From what we've seen, any of these GeForce DDR boards has just as much right to the Gear of the Year award as the Annihilator Pro, since they all follow nVidia's design damn closely.

nVidia's GeForce 256 is one burly graphics processor. Packed with 23 million transistors, it's currently the only chip capable of offloading geometry transform-and-lighting from the CPU—a feature still on the drawing board (or in S3's case, the trash bin) for every other 3D chipmaker. The GeForce is also the only graphics processor with a four-pixel pipeline, which means smooth frame rates in single-texture lightshows such as *Forsaken*, and multitexture gore-fests such as *Unreal Tournament*. Along with its title of "Most Complex 3D Chip to Grace the Surface of a Videocard," nVidia's GeForce is also the chip most likely to need special care and feeding. Chalk it up to the chip's insatiable need for bandwidth.



The 3D Prophet DDR-DVI arrives loaded with TV-out and DVI, and delivers the fastest GeForce experience around.

PLUSES

3D PROPHET DDR-DVI
- Supports new DVI standard
- Built-in overclocking slider
- Excellent DVD playback software

WINFAST GEFORCE DDR
- Overclocking utility
- Well-implemented driver tweaks

ERAZOR X²
- Works well with cool 3D Revelator glasses
- Well-designed drivers with excellent monitor support

MINUSES

3D PROPHET DDR-DVI
- Low-ambition-level driver innovation
- TV-out isn't very good

WINFAST GEFORCE DDR
- TV-out isn't very good

ERAZOR X²
- TV-out isn't very good

Leadtek may not be a big name in videocards, but if the company keeps making cards like the WinFast GeForce DDR, it will be soon.

Like most graphics processors, the GeForce 256 interfaces with onboard memory across a 128-bit bus. But, unlike other 3D chips, the GeForce is capable of pushing the kind of fill rates that saturate the memory bus at higher resolutions and color depths. In a complex game such as *Quake III*, the 128-bit memory interface starts to hamper performance at 1024x768 in 32-bit color. At higher resolutions the problem is even more noticeable, with the chip moving even larger amounts of data back and forth into video memory. Some companies, such as ATI and 3dfx, are attempting to alleviate this bottleneck with dual-proc, dual-memory architectures. In this setup, each graphics processor has its own chunk of memory to play with, allowing the division of complex rendering chores between two or more chips, and yielding increased fill rates. The downside is that it requires twice, or even four times as much video memory, and the extra RAM often goes to waste, with separate copies of the same data stored in each memory bank.

The solution for nVidia is to use double data rate (DDR) memory. Employing a technique similar to that used by the AGP bus to achieve 2x and 4x speeds, DDR allows memory chips to send data on both the rising and falling edge of a clock pulse. This doubles the effective transfer speed of the bus without having to run the memory clock faster, and gives the GeForce enough room to plow through even the most complex scenes without having to suck in its gut.

The difference in performance between SDR (single data rate) and DDR GeForce boards translates into about 15 more fps in our *Quake III* timedemo, and about 6 more fps in our new *Unreal Tournament* benchmark (which will debut next issue). When it comes to DDR memory, the more complex the graphics, the bigger the potential payoff. In games that don't move a lot of geometry or textures across the memory bus, the difference will be negligible. In our *Expendable* and *Half-Life* timedemos, for instance, we recorded minor frame rate differences between the SDR and DDR flavors of GeForce.

Since none of the GeForce DDR boards reviewed here vary from nVidia's reference design, each delivers the same core features and performance. Sure, they're packaged

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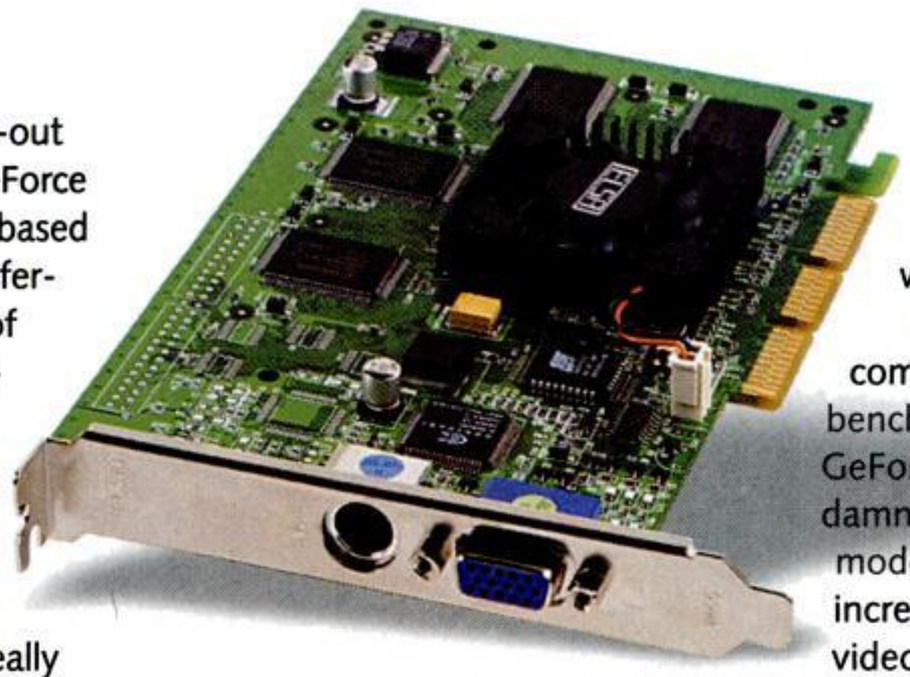
differently, and some have TV-out and DVI support. But each GeForce DDR board ships with drivers based on some version of nVidia's reference drivers (version 3.76 as of this press time). Also, the suggested core clock for the GeForce is 120MHz, which only the 3D Prophet exceeds with its default 130MHz. Oddly enough, the increased clock speed didn't really make a difference in our benchmarks. However, higher clock speeds will definitely be advantageous when games that actually test the GeForce's full potential appear.

Given the similar configurations of these boards, figuring out which GeForce DDR board to buy is more a question of price, availability, and the reputation of the company that makes the card. Here's a quick rundown of what makes each DDR GeForce board unique:

Just as the name indicates, the Hercules 3D Prophet DDR-DVI includes a DVI interface that's meant to power the upcoming generation of digital TFT displays. It's the only board in this roundup that supports DVI. While the board outputs a crystal-clear signal with incredibly sharp results to a flat-panels or digital monitors, such displays are still few and far between. In other words, don't base your buying decision on a display interface standard that won't be commonly used until sometime next year.

The 3D Prophet's S-video out does a decent, if unimpressive job of



The Elsa Erazor X² isn't very fancy, but it's pretty damn rock solid.

kicking low resolution screens out to your TV. (It doesn't allow you to use the monitor while the TV is active.) Unfortunately, neither the Leadtek nor the Elsa board does TV-out any better.

On the driver front, Hercules/Guillemot simply repackaged nVidia's reference drivers, offering no innovation beyond what nVidia has already incorporated. This is a far cry from the tweaks that have been added to the drivers bundled with the Leadtek WinFast GeForce DDR and the Elsa Erazor X². Both include custom monitor configuration utilities (Elsa's is particularly impressive, with its massive monitor database), easy-to-access 3D tweaks such as V-sync enable/disable, and handy color correction tools.

Both the WinFast and 3D Prophet add overclocking sliders to the display control panel, allowing you to conceivably take the core clock to 165MHz and the memory clock to 190MHz. Of course, you'll need plenty of power and a lot of cooling to keep your system from crashing with these settings. The Erazor X² doesn't come with an overclocking tool.

As you can see from the comparisons above and the benchmarks below, these three GeForce DDR videocards are damn similar. All deliver moderate performance increases over every other videocard on the market, and really show their stuff when running next-generation games, particularly those that take advantage of hardware transform and lighting acceleration. If you're considering a new GeForce board, you should definitely spring for one with DDR memory. In the long run, you'll be glad you did.

—Sean Downey

THE SPECS

AGP SUPPORT	Full AGP 2x/4x with fast writes
RAMDAC	350MHz
MAX 32-BIT RES	2048x1536
MAX 16-BIT RES	2048x1536
REFRESH RATE	1600x1200: 85Hz

3D PROPHET DDR-DVI — 9

$299 | Hercules/Guillemot
877.484.5536 | www.hercules.com
RS Connect with this product at readershop.com/mpc0424
877-751-7467 ID#0424

WINFAST GEFORCE DDR — 9

$269 | Leadtek | 510.490.8076
www.leadtek.com
RS Connect with this product at readershop.com/mpc0425
877-751-7467 ID#0425

ERAZOR X² — 9

$299 | Elsa | 800.272.3572
www.elsa.com
RS Connect with this product at readershop.com/mpc0426
877-751-7467 ID#0426

DARE TO COMPARE

	ANNIHILATOR PRO	3D PROPHET DDR-DVI	WINFAST GEFORCE DDR	ERAZOR X²
Clock Speed	120MHz bus/ 150MHz memory	130MHz bus/ 150MHz memory	120MHz bus/ 150MHz memory	120MHz bus/ 150MHz memory
Local Memory	32MB DDR SDRAM	32MB DDR SDRAM	32MB DDR SDRAM	32MB DDR SDRAM
Bundled Software	Win98 drivers NT4.0 drivers Intervideo *WinDVD* E-Color *Colorific* and *3Deep*	Win98 drivers NT4.0 drivers XingDVD Player	Win98 drivers NT4.0 drivers *WinFast DVD* E-Color *Colorific* and *3Deep*	Win98 drivers NT4.0 drivers

BENCHMARKS	ANNIHILATOR PRO	3D PROPHET DDR-DVI	WINFAST GEFORCE DDR	ERAZOR X²
Quake III: Arena 1024x768 32-bit color	47.6fps	47.7fps	49fps	**51.1fps**
Half-Life 800x600 16-bit color	36fps	**36.1fps**	36fps	30.5
Expendable 1024x768 16-bit color	53.2fps	54.7fps	**54.8fps**	**54.8fps**
Descent 3 800x600 16-bit color	47.1fps	**47.4fps**	47.3	46.9fps

NOTES: Benchmarked on our Dell 500MHz Pentium III test system using version 3.53 of the Creative drivers, version 3.62 of the Hercules drivers, version 3.72 of the Leadtek drivers, and version 3.59 of the Elsa drivers. V-Sync is enabled in every benchmark. **Bold** indicates the best benchmark score.

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CD-RWs for the masses

NEW VENDORS BRING SPEED, QUALITY TO IDE REALM

Not everyone can afford a SCSI-based CD-RW, and some think SCSI is a pain in the cache anyway, so they opt for an IDE burner. After all, IDE is easier to set up, costs significantly less than SCSI, and offers comparable average speeds.

Thanks to the proliferation of the MP3 phenomenon, there's been huge growth in the IDE drive market and vendors are dashing to provide the requisite hardware. Two heavy-hitters have now entered the IDE arena: TDK and Plextor. For years, Hewlett Packard has led the US IDE CD-RW market, but will be facing stiff competition from these upstarts, which bring a whole lot more to the table than just their good names.

TDK's VeloCD rips audio faster than the competition, and is the only drive to bundle MP3 encoding software.

PLUSES

VELOCD
- Fast
- 16x ripping
- Killer software

PLEXWRITER
- Speedy
- Solid reputation

CD-WRITER 9100L
- Quick access times

MINUSES

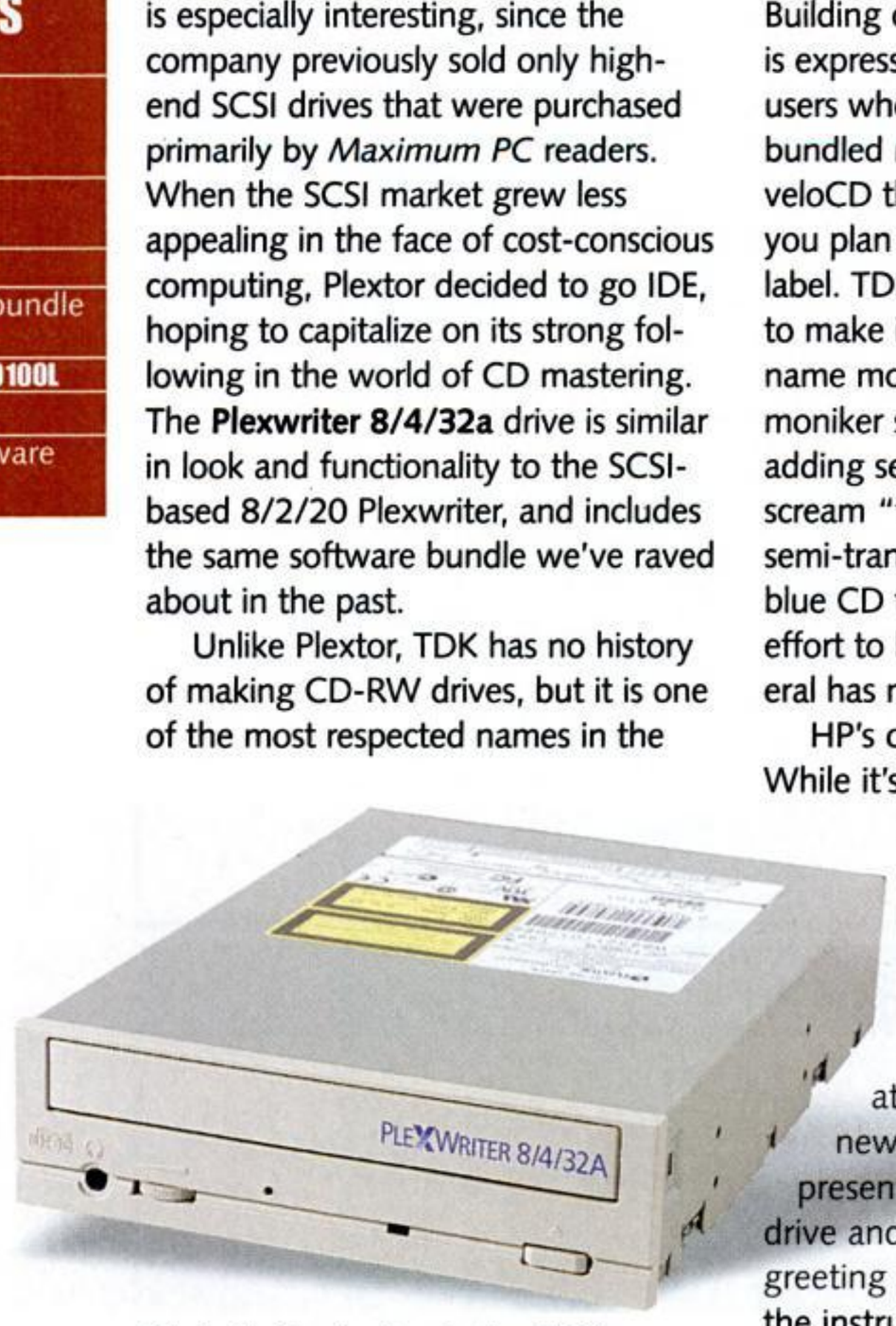
VELOCD
- Confusing software interface
- Tray is iMac blue

PLEXWRITER
- Software bundle is lacking

CD-WRITER 9100L
- Slow
- Extra software is useless

Plextor's entry into the IDE world is especially interesting, since the company previously sold only high-end SCSI drives that were purchased primarily by *Maximum PC* readers. When the SCSI market grew less appealing in the face of cost-conscious computing, Plextor decided to go IDE, hoping to capitalize on its strong following in the world of CD mastering. The **Plexwriter 8/4/32a** drive is similar in look and functionality to the SCSI-based 8/2/20 Plexwriter, and includes the same software bundle we've raved about in the past.

Unlike Plextor, TDK has no history of making CD-RW drives, but it is one of the most respected names in the CD media market. The **veloCD**'s advertised 20x ripping speed is roughly twice as fast as that of other CD-RWs with similar drive ratings. Building on its audio heritage, TDK is expressly targeting its drive at users who want to rip audio, and has bundled more audio software with the veloCD than you'll ever need, unless you plan to start your own record label. TDK also went to great lengths to make its drive "cool," giving it a name more exciting than a vanilla moniker such as CD-Writer, and adding several other touches that scream "focus group," including the semi-transparent tray door and iMac-blue CD tray. We appreciate TDK's effort to be different, but a PC peripheral has no place looking like an iMac.



Plextor's drive isn't as fast as TDK's offering, but it has a CD-RW reputation that TDK can't match—yet.

HP's offering is decidedly less sexy. While it's true that HP is the market leader, quantity doesn't always equal quality, as illustrated by the record sales of the band 'NSYNC. The **HP CD-Writer 9100i** drive is seemingly targeted at soccer moms and computer newbies; it includes a video presentation on installing the drive and using software for making greeting cards. While we appreciate the instructional video (TDK provides one as well, albeit in VHS format), the bulk of the software package is an odd mixture of programs we'd never use in everyday CD-mastering tasks. And in case you are too inexperienced to even know when to use *Direct CD* versus Adaptec *Easy CD Creator*, HP has built a Shockwave interface that helps you decide which program to use. The interface asks you what type of CD you'd like to create; based on your choice, it launches the program best suited (in HP's opinion) for the task ahead. To be honest, this newbie stuff pisses us off, and we'd love an option for "advanced users" to ditch the Shockwave interface and access the programs directly.

All three of these drives sport the same 8/4/32 speed rating, but performance varied enough to expose a clear winner: TDK's veloCD. In terms of pure speed, the veloCD is the fastest of the three for CD copying and audio extraction. By a hair, the TDK drive outpaced the Plexwriter to earn fastest-drive-rating bragging rights, but it trounced the venerable Plextor by a margin of 50 seconds in audio extraction and almost three minutes in mixed mode CD duplication. Given that all drives have the same 8x recording and 32x read speeds, we found the vast differences in benchmark results to be surprising. The scores were similar across the board in sequential read speeds, CPU

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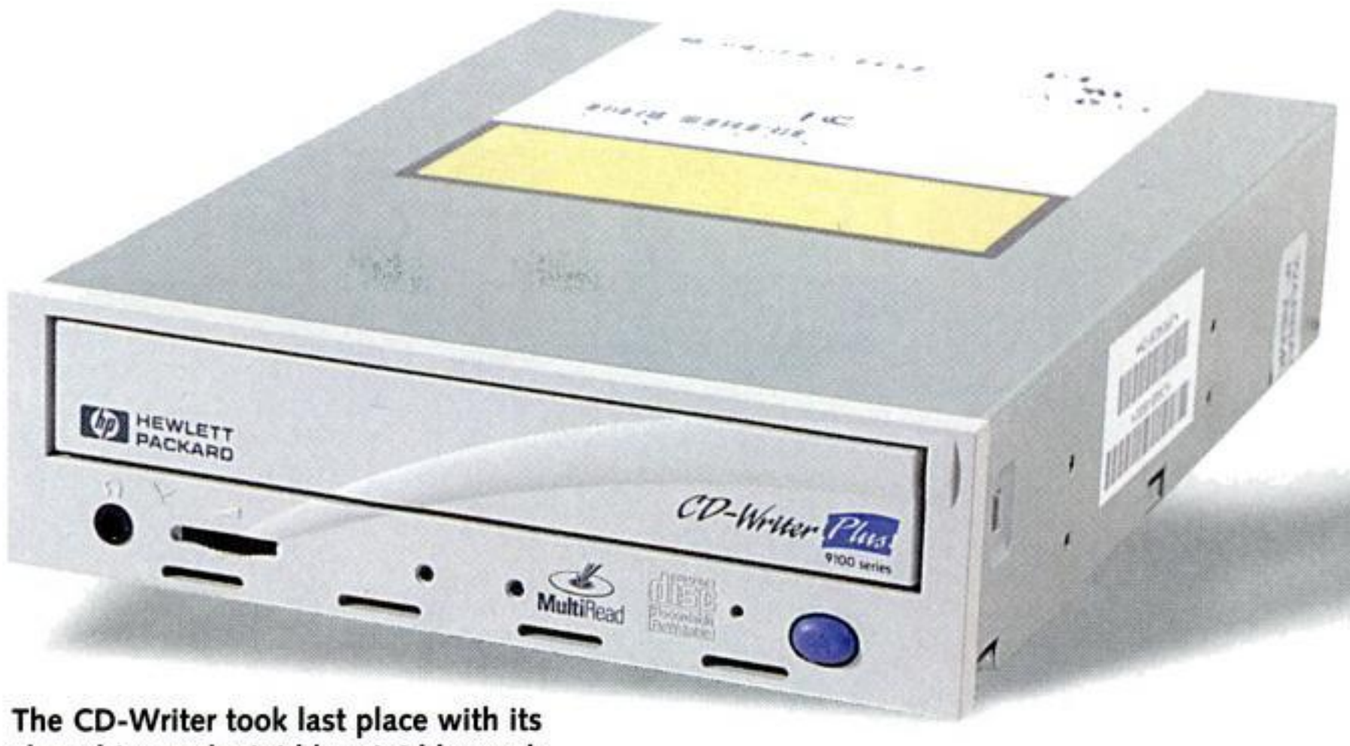
utilization, and data CD creation, but fluctuated wildly in audio extraction and mixed mode CD duplication tests.

Dealing with audio data is always a true test of a drive's worth, and it seems in this roundup that anytime audio data was inserted into the mix, the TDK and Plextor drives left the HP drive in the dust. Even more surprising is that Plextor has a reputation for making the fastest, most reliable drives for audio duties, but the TDK veloCD spanked it in audio tests.

As you may have guessed, the HP drive placed dead last in almost all of our tests, scoring 1x below the other drives in drive rating and taking longer to perform all timed duplication tests. The drive's only advantage is in random and full-stroke access times, making it good at finding data on disks that aren't sequentially written, such as Microsoft *Encarta* or other programs full of data. However, the fact that the HP took almost twice as long as the TDK drive to perform audio extraction makes it our last choice for making music CDs—which isn't surprising, since the CD-Writer is the only drive in this roundup that doesn't include audio extraction software.

It should be noted that we think it's foolish for any drive maker, in this day and age, not to include audio extraction and MP3 encoding software with its drives. Only the TDK drive has both, and we call on other manufacturers to grow some cajones and follow suit.

On that note, the TDK also takes the prize for its software bundle. Its proprietary *CD Blender* software does bit-for-bit accurate copying, includes a music player, and decodes



The CD-Writer took last place with its slow drive and wigiddy-wigiddy-wack software package.

CDA tracks to WAV format on the fly. TDK's is also the only bundle in this roundup to include *MusicMatch Jukebox* for ripping and encoding MP3s, which is a nice touch. Our only complaints are with the confusing interfaces that TDK has created. Each application looks as though it came from the Jetsons, featuring circles, flashing arrows, and lights that are obviously designed to look...how do the kids say? Phat? It confused us enough to make us read the manual, and we hate reading manuals.

The Plextor software package is the same suite we've seen numerous times before, but its current configuration is much less useful. For instance, the *DiscDupe* program works only with a Plexwriter drive as the source—but if you already own a Plexwriter drive, it's SCSI, so you probably won't be buying an IDE drive for CD mastering. The *CD Res-Q* program for creating bootable backup CDs has been excluded from the package, which sucks. The included audio extraction software lets you view CD audio tracks as WAV files, but won't let you encode them to MP3 format. TDK's software offers the same feature, but goes that extra step.

As mentioned previously, HP bundles a bizarre assortment of programs with its drive. *Easy CD Creator* and *Direct CD* are great for CD mastering, but who needs *Filing Central* to organize faxes, web pages, and images in a virtual file cabinet, or *Corel Print Office* to crank out calendars and stationary? Maybe we're out of touch with the marketplace, but who buys a CD-RW to make calendars or file faxes? We certainly don't, but if you do, the HP is the drive for you.

For the rest of us, it comes down to the TDK and the Plextor. Plextor has a good name, but with great speed and all the software we desire in a CD-RW package, the TDK's veloCD takes the cake as a total package. The Plextor is an excellent drive, but its software suite is lacking compared to the TDK's, ruining what would have otherwise been an excellent verdict.

—Josh Norem

REAL WORLD BENCHMARKS

MANUFACTURER	HP CD-WRITER 9100I	PLEXWRITER 8/4/32A	TDK VELOCD
CD TACH			
Drive Rating	20.5x	21.3x	21.4x
Full Stroke/Random Access (in milliseconds)	200 / 153	296 / 154	301 / 159
Maximum sequential read speeds	4.5MB/sec	4.48MB/sec	4.84MB/sec
Minimum sequential read speeds	2.09MB/sec	2.07MB/sec	2.08MB/sec
CPU Utilization (Min/Max)	4% / 43%	6% / 51%	6% / 50%
Audio extraction time for 346MB (min:sec)	7:00	4:37	3:47
Buffer Size	4MB	4MB	4MB
Support for over-burning	No	Yes	Yes
Mixed mode CD duplication (min:sec)	9:37	12:08	11:48
Data CD creation (min:sec)	20:18	19:57	20:35

HP CD-WRITER 9100I — 5

$300 | Hewlett Packard
800.613.2222 | www.hpcdwriter.com
Connect with this product at readershop.com/mpc0429
877-751-7467 ID#0429

PLEXWRITER 8/4/32A — 8

$310 | Plextor | 800.886.3935
www.plextor.com
Connect with this product at readershop.com/mpc0428
877-751-7467 ID#0428

TDK VELOCD — 9

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516.625.0100 | www.tdk.com
Connect with this product at readershop.com/mpc0427
877-751-7467 ID#0427

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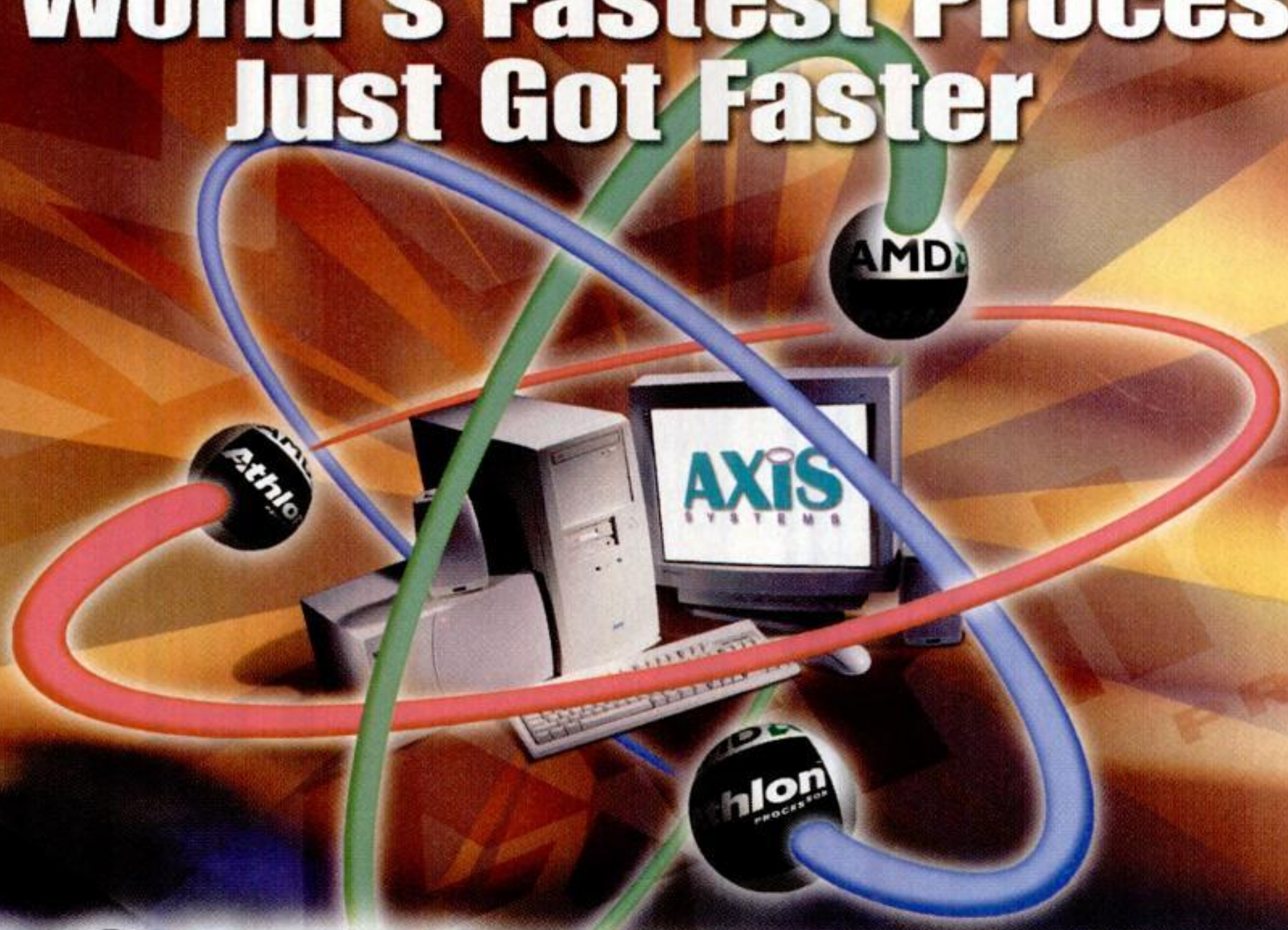

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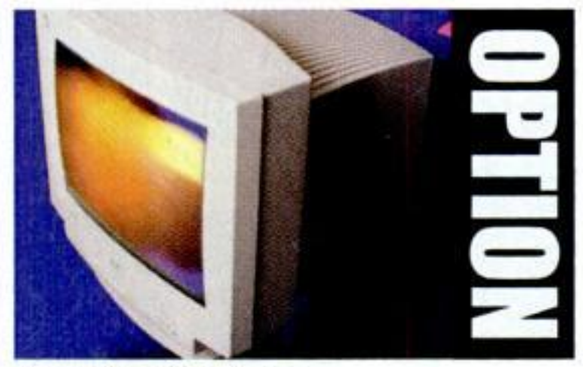

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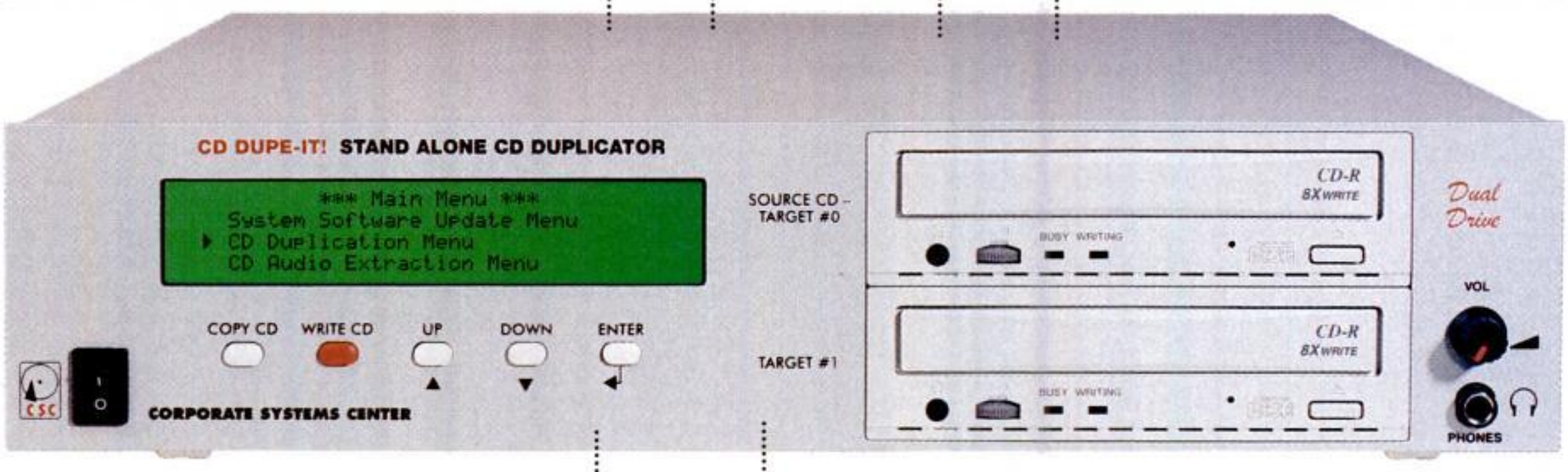

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Part Number	Chip Set	L2 Cache (KB)	Maximum Memory (MB)	168-pin DIMM Sockets	72-pin SIMM Sockets	Flash BIOS	Integrated Audio	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/AMD-K6®-2/450 with 3DNow!™	w/AMD-K6-2/500	w/AMD-K6-2/550	w/AMD-K6-III/400	w/Intel® Pentium® MMX™ 233MHz
Asus P5A-B	*MB5711*	ALi Aladdin V	512	384	3		Award		3	2	1	Baby AT	1 Yr.	$92	$151	$160	$222	$177	$137
EPoX EP-MVP3C2	*MB5406*	VIA Apollo MVP3	512	384	3		Award	UltraDMA/66	4	2	1	Baby AT	2 Yrs.	$83	$142	$151	$213	$168	$128
EPoX EP-MVP3G5	*MB5405*	VIA Apollo MVP3	2048	384	3		Award	UltraDMA/66	5	2	1	ATX	2 Yrs.	$114	$173	$182	$244	$199	$159
FIC PA-2013 (2MB Cache)	*MB5214*	VIA Apollo MVP3	2048	384	3		Award		4	2	1	ATX	1 Yr.	$103	$162	$171	$233	$188	$148
FIC VA-503+	*MB5211*	VIA Apollo MVP3	1024	512	2	4	Award		3	3	1	Baby AT	1 Yr.	$79	$138	$147	$209	$164	$124
FIC VA-503A	*MB5212*	VIA Apollo MVP3	1024	768	3		Award	ESS UltraDMA/66	4	1	1	Baby AT	1 Yr.	$87	$146	$155	$217	$172	$132
Shuttle HOT-591P	*MB5611*	VIA Apollo MVP3	512	256	2	2	Award		3	3	1	Baby AT	1 Yr.	$78	$137	$146	$208	$163	$123
Tyan S1590S Trinity 100AT	*MB5006*	VIA Apollo MVP3	1024	384	3	2	Award		4	4	1	Mini AT	3 Yrs.	$95	$154	$163	$225	$180	$140
Tyan S1598 Trinity ATX	*MB5008*	VIA Apollo MVP3	2048	384	3		Award	UltraDMA/66	5	2	1	ATX	3 Yrs.	$121	$180	$189	$251	$206	$166

Slot A

Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Bus Frequency	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/AMD Athlon™ 600MHz	w/AMD Athlon 650MHz	w/AMD Athlon 700MHz	w/AMD Athlon 750MHz	w/AMD Athlon 800MHz	w/AMD Athlon 850MHz
AMI Megathon	*MB7301*	AMD-751 / VIA 686A	768	3	Award	100	UltraDMA/66	5	1	1	ATX	1 Yr.	$177	$407	$437	$487	$597	$787	$1047
Asus K7M	*MB7701*	AMD-751 / VIA 686A	768	3	Award	100/120/133	UltraDMA/66	5	1	1	ATX	1 Yr.	$167	$397	$427	$477	$587	$777	$1037
EPoX EP-K7VA	*MB7850*	VIA Apollo KX133	768	3	Award	200/133	UltraDMA/66	5	1	1	ATX	1 Yr.	$199	$429	$459	$509	$619	$809	$1069
FIC SD11	*MB7401*	AMD-751 / VIA 686A	768	3	Award	100	UltraDMA/66	5	1	1	ATX	1 Yr.	$139	$369	$399	$449	$559	$749	$1009
GVC QS750	*MB7601*	AMD-750	768	3	Award	100	UltraDMA/66	4	3	1	ATX	1 Yr.	$139	$369	$399	$449	$559	$749	$1009
Microstar MS-6167	*MB7201*	AMD-750	768	3	Award	100	UltraDMA/66	5	2	1	ATX	1 Yr.	$166	$396	$426	$476	$586	$776	$1036
Shuttle AI61	*MB7901*	AMD-750	768	3	Award	100	UltraDMA/66	5	0	1	MicroATX	1 Yr.	$135	$365	$395	$445	$555	$745	$1005

Socket 370

Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Integrated Audio	Integrated Video	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	AMR Slot	Format	Manufacturer's Warranty	Motherboard Only	w/Intel® Celeron™ processor 466MHz 128K OD 66MHz FSB	w/Intel Celeron 500/A 128K OD 66MHz FSB	w/Intel Celeron 533/A 128K OD 66MHz FSB	w/Intel Celeron 566 128K OD 66MHz FSB	w/Intel Celeron 600 128K OD 66MHz FSB	w/Dual Intel Celeron 600 128K OD 66MHz FSB	w/Intel Pentium® III 550E 256K OD 100MHz FSB	w/Intel Pentium III 600E/EB 256K OD 100/133MHz FSB	w/Intel Pentium III 667 256K OD 133MHz FSB	w/Intel Pentium III 733 256K OD 133MHz FSB	w/Intel Pentium III 800/EB 256K OD 100/133MHz FSB
ABIT BP6 (Dual)	*MB6506*	Intel 440BX	768	3	Award			5	2	1		ATX	1 Yr.	$144	$233	$257	$299	$344	$364	$584	N/A	N/A	N/A	N/A	N/A
EPoX EP-3VBA2 (3VCA)	*MB6854*	VIA Apollo Pro 133A	768	3	Award	AC-97		4	1	1	1	ATX	2 Yrs.	$120	$209	$233	$275	$320	$340	N/A	$350	$410	$520	$660	$890
SuperMicro 370SCD	*MB6159*	Intel® 820	512	2	AMI	AC-97		5		1	1	ATX	1 Yr.	$149	$238	$262	$304	$349	$369	N/A	$379	$439	$549	$689	$919
SuperMicro 370SEA	*MB6140*	Intel 810e	512	2	AMI	Intel 810e	Intel 810e	6	1		1	ATX	1 Yr.	$134	$223	$247	$289	$334	$354	N/A	$364	$424	$534	$674	$904
SuperMicro 370SWD	*MB6139*	Intel 810	512	2	AMI	Intel 810	Intel 810	3			1	Micro ATX	1 Yr.	$119	$208	$232	$274	$319	$339	N/A	$349	N/A	N/A	$659	N/A
Tyan S1857 Trinity 371	*MB6017*	Intel 440BX	768	3	AMI			6	1	1		ATX	3 Yrs.	$105	$194	$218	$260	$305	$325	N/A	N/A	N/A	N/A	N/A	N/A
Tyan S1854 Trinity 400	*MB6018*	VIA Apollo Pro 133A	768	3	Award			6	1	1		ATX	3 Yrs.	$111	$200	$224	$266	$311	$331	N/A	$341	$401	$511	$651	$881

Slot 1

Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	168-pin RIMM Sockets	Flash BIOS	Integrated Audio	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/Intel® Pentium III® processor 533EB MHz 256K OD 133MHz FSB	w/Intel Pentium III 550 512K 100MHz FSB	w/Intel Pentium III 600E/EB 256K OD 100/133MHz FSB	w/Intel Pentium III 650 256K OD 100MHz FSB	w/Intel Pentium III 700 256K OD 100MHz FSB	w/Intel Pentium III 733 256K OD 133MHz FSB	w/Intel Pentium III 750 256K OD 100MHz FSB	w/Intel Pentium III 800/EB 256K OD 100/133MHz FSB	w/Intel Pentium III 866 256K OD 133MHz FSB	w/Dual Intel Pentium III 850 256K OD 100MHz FSB
ABIT BE6-II	*MB6508*	Intel 440BX	768	3		Award	UltraDMA/66	5	1	1	ATX	1 Yr.	$147	N/A	$377	$437	$522	$642	N/A	$777	$917	N/A	N/A
ABIT BF6	*MB6507*	Intel 440BX	768	3		Award	UltraDMA/66	6	1	1	ATX	1 Yr.	$122	N/A	$352	$412	$497	$617	N/A	$752	$892	N/A	N/A
ABIT VA6	*MB6509*	VIA Apollo Pro 133	768	3		Award	AC-97 UltraDMA/66	5	2	1	ATX	1 Yr.	$90	$320	$320	$380	$465	$585	$630	$720	$860	$1020	N/A
Asus P2B98-DS	*MB6707*	Intel 440BX	1024	4		Award		4	2	1	ATX	1 Yr.	$469	N/A	$699	$759	$844	$964	N/A	$1099	$1239	N/A	$2289
Asus P2B-B	*MB6714*	Intel 440BX	768	3		Award		4	2	1	Baby AT	1 Yr.	$139	N/A	$369	$429	$514	$634	N/A	$769	$909	N/A	N/A
Asus P3B-F	*MB6720*	Intel 440BX	1024	4		Award		6	1	1	ATX	1 Yr.	$143	N/A	$373	$433	$518	$638	N/A	$773	$913	N/A	N/A
Asus P3C2000	*MB6722*	Intel 820	1024	4		Award	AC-97 UltraDMA/66	5	1	1	ATX	1 Yr.	$169	$399	$399	$459	$544	$664	$709	$799	$939	$1099	N/A
EPoX EP-6VBA2	*MB6855*	VIA Apollo Pro 133A	768	3		Award	AC-97 UltraDMA/66	4	2	1	ATX	3 Yrs.	$114	$344	$344	$404	$489	$609	$654	$744	$884	$1044	N/A
FIC KA11	*MB6411*	VIA Apollo Pro 133A	1024	4		Award	UltraDMA/66	5	2	1	ATX	1 Yr.	$101	$331	$331	$391	$476	$596	$641	$731	$871	$1031	N/A
Intel CC820	*MB6919*	Intel 820	512	2		Intel/Phoenix	UltraDMA/66	5		1	ATX	3 Yrs.	$146	$376	$376	$436	$521	$641	$686	$776	$916	$1076	N/A
Intel VC820	*MB6920*	Intel 820	512		2	Intel/Phoenix	UltraDMA/66	5		1	ATX	3 Yrs.	$175	$405	$405	$465	$550	$670	$715	$805	$945	$1105	N/A
Intel SE440BX-2 "Seattle"	*MB6921*	Intel 440BX	768	3		Intel/Phoenix		4	2	1	ATX	3 Yrs.	$135	N/A	$365	$425	$510	$630	N/A	$765	$905	N/A	N/A
Shuttle AV61	*MB6308*	VIA Apollo Pro 133	768	3		Award	AC-97 UltraDMA/66	5	2	1	ATX	1 Yr.	$81	$311	$311	$371	$456	$576	$621	$711	$851	$1011	N/A
SuperMicro PIIISCD	*MB6146*	Intel 820	512	2		AMI	AC-97 UltraDMA/66	5		1	ATX	1 Yr.	$155	$385	$385	$445	$530	$650	$695	$785	$925	$1085	N/A
SuperMicro PIIISED	*MB6142*	Intel 810e	512	2		AMI	AC-97 UltraDMA/66	6			ATX	1 Yr.	$130	$360	$360	$420	$505	$625	$670	$760	$900	$1060	N/A
SuperMicro PIIIDME	*MB6151*	Intel 840	4096	4		AMI	AC-97 Intel PRO/100+	6		1	ATX	1 Yr.	$329	$559	Call	$619	Call	Call	$869	Call	Call	$1259	Call
SuperMicro PIIIDM3	*MB6153*	Intel 840	4096	4		AMI	AC-97 Adaptec Ultra3/160	6		1	ATX	1 Yr.	$499	N/A	$729	$789	$874	$994	N/A	$1129	$1269	N/A	$2319
SuperMicro P6DGH	*MB6129*	Intel 440GX	2048	4		AMI	Adaptec 2-Ch U2W	9	2	1	Full AT	1 Yr.	$809	N/A	$1039	$1099	$1184	$1304	N/A	$1439	$1579	N/A	$2629
SuperMicro P6SBA	*MB6120*	Intel 440BX	768	3		AMI		4	3	1	ATX	1 Yr.	$104	N/A	$334	$394	$479	$599	N/A	$734	$874	N/A	N/A
SuperMicro P6SBU	*MB6128*	Intel 440BX	1024	4		AMI	Adaptec U2W	4	3	1	ATX	1 Yr.	$329	N/A	$559	$619	$704	$824	N/A	$959	$1099	N/A	N/A
Tyan S1854 Trinity 400	*MB6018*	VIA Apollo Pro 133A	768	3		Award	UltraDMA/66	6	1	1	ATX	3 Yrs.	$111	$341	$341	$401	$486	$606	$651	$741	$881	$1041	N/A

Slot 2

Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Integrated Audio	Integrated Video	Integrated Controller	Integrated Networking	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/Intel Pentium III Xeon 550MHz 512K	w/Intel Pentium III Xeon processor 550MHz 1024K cache	w/Intel Pentium III Xeon 550MHz 2048K	w/Dual Intel Pentium III Xeon 550MHz 512K	w/Dual Intel Pentium III Xeon 550MHz 1024K	w/Dual Intel Pentium III Xeon 550MHz 2048K	w/Quad Intel Pentium III Xeon 550MHz 512K	w/Quad Intel Pentium III Xeon 550MHz 1024K	w/Quad Intel Pentium III Xeon 550MHz 2048K
AMI MegaPlex II	*MB6215*	Intel 450NX	4096	16	AMI	2MB ATI			7	1		9U Rack	1 Yr.	$3995	$5095	$6325	$8335	$6195	$8655	$12675	$8395	$13315	$21355
SuperMicro S2DM3	*MB6156*	Intel 840	4096	4	AMI	AC-97	Adaptec Ultra3/160m	Intel PRO/100+	6		1	ATX	1 Yr.	Call	Call	Call	Call	Call	Call	Call	N/A	N/A	N/A
SuperMicro S2DME	*MB6160*	Intel 840	4096	4	AMI	AC-97		Intel PRO/100+	6		1	ATX	1 Yr.	Call	Call	Call	Call	Call	Call	Call	N/A	N/A	N/A
SuperMicro S2DG2	*MB6136*	Intel 440GX	2048	4	AMI		Adaptec 2-Ch U2W		5	2	1	ATX	1 Yr.	$549	$1649	$2879	$4889	$2749	$5209	$9229	N/A	N/A	N/A
SuperMicro S2DGE	*MB6135*	Intel 440GX	2048	4	AMI				5	2	1	ATX	1 Yr.	$329	$1429	$2659	$4669	$2529	$4989	$9009	N/A	N/A	N/A

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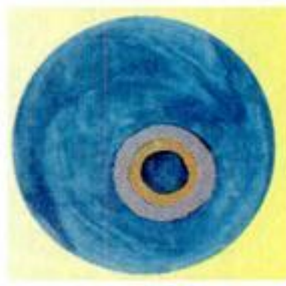

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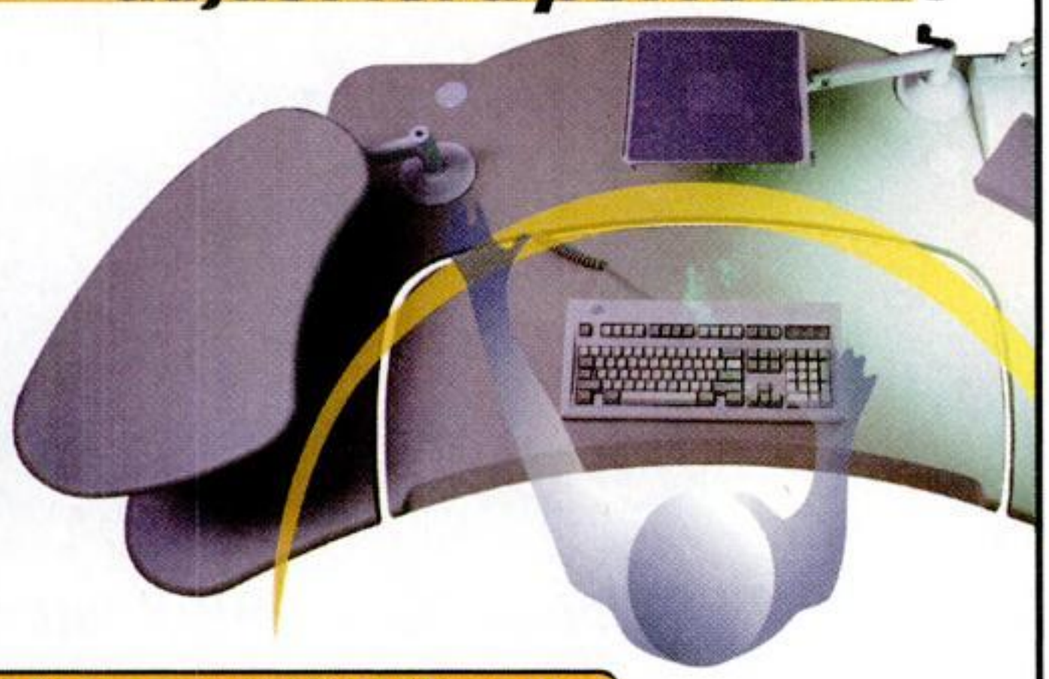

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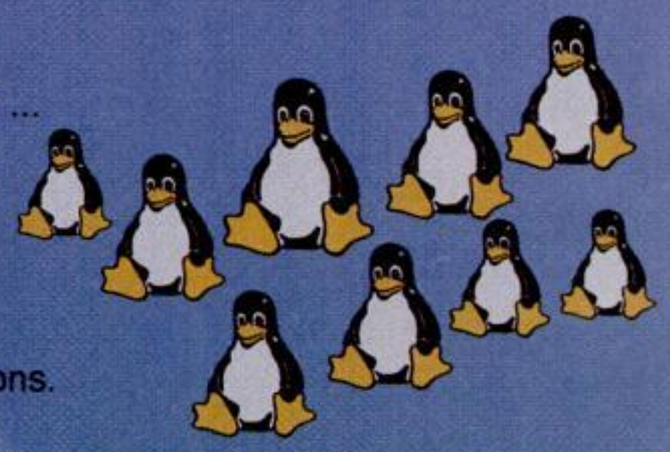

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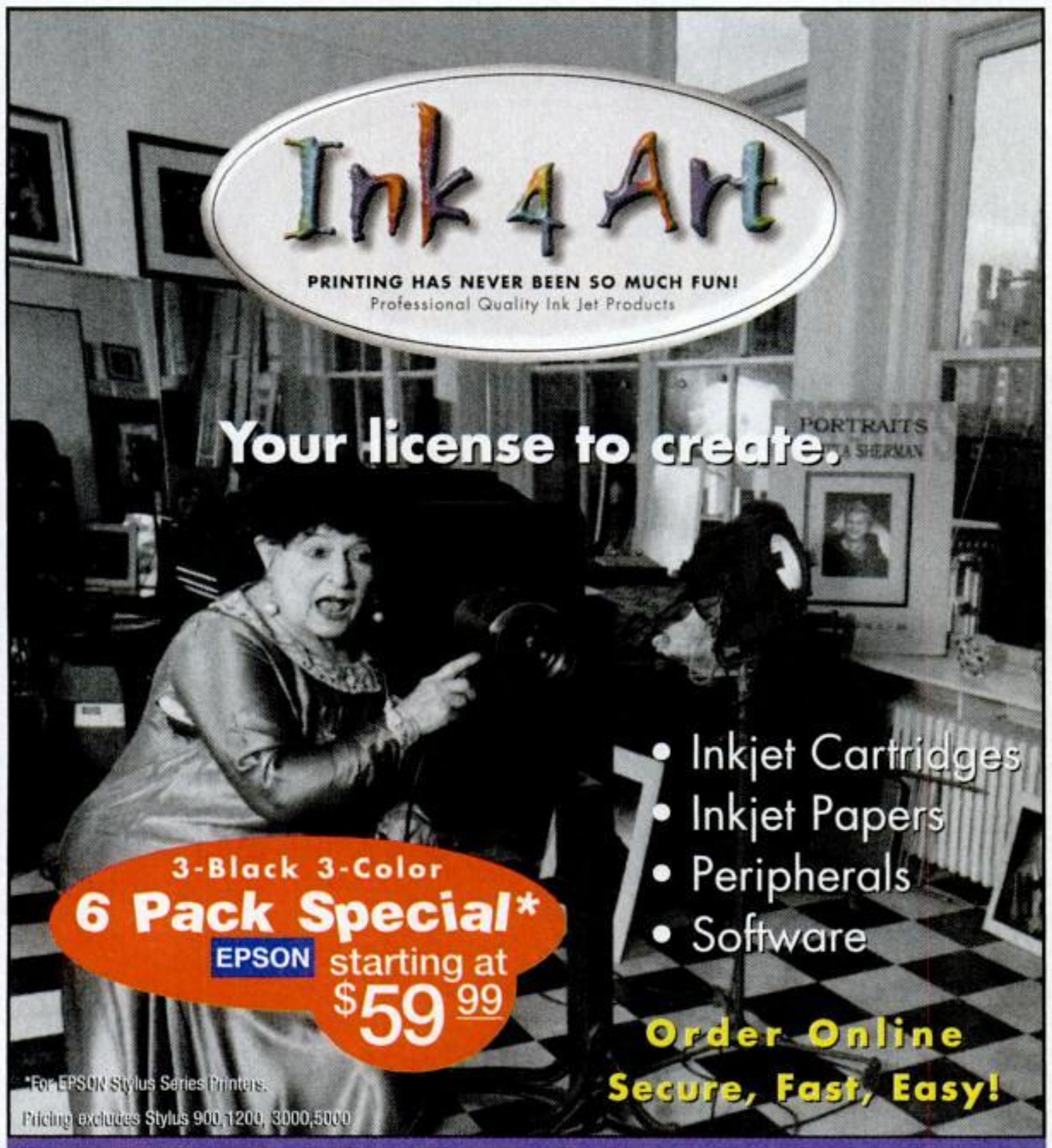
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glitch

BY JON PHILLIPS

BAD COMPUTER ADVICE JAMBOREE!

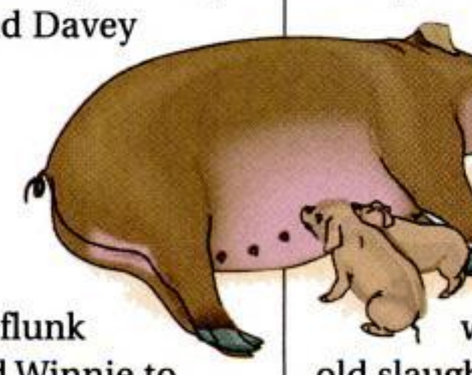
PC fixin' with Verlin Weevil, System Architect, Conner County Department of Corrections

Faster frame rates? Faster frame rates? If you think one of them newfangled AGP cards is the answer to faster frame rates, ya'll better pay your dues to the Intel Booty Buddies Club, 'cause that kind of brown-nosin' will cost you dearly. I repeat: Booty-buttin' brown-nosin' will cost you DEARLY! AGP ain't nothin' but an Intel conspiracy, orchestrated in cahoots with the Big Five Videocard Consortium, the Pyongyang Memory Council, the Clayton County Promise Keepers Task Force, and Suge Knight, the Chairman and CEO of No Limit Records, thank you sir, may I have another, end of story, that's all she wrote.

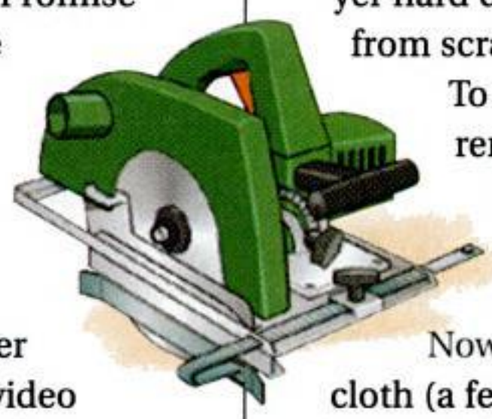
Now if you really want faster frame rates in computerized video games, you'll get yerself a smaller monitor. Less of them pixels dancin' the hokey-pokey onscreen means less pixel-pumpin' chores for yer videocard, and up go yer frame rates, straight to the moon, like a prairie dog with a signal flare up its ass. Woooooo-hee!

You say yer tired of hearin' yer hard disk just a'thrashin' and a'slashin' like a copperhead with its noggin nixed? See, the problem is that every time you run out of "main system memory"—that'd be yer EDO rams, yer SDRAM rams, and yer LMNOP rams—yer operatin' system takes over and starts juicin' up yer hard drive's "swap file." I mean that swap file starts workin' yer hard drive like the town pump! Solution? Delete that swap file! I mean, delete the *hell* out of it. If you don't think that'll quiet yer old drive down, then yer a day-dream believer, just like old Davey Jones said.

Payback's a bitch, ain't it, swappy?



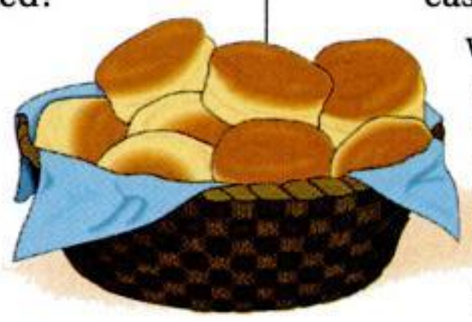
Is yer Windows operatin' system givin' you lip? I say flunk that back-talk and send old Winnie to the dust-bin—all you need to do is wipe yer hard drive and reinstall the OS from scratch.



To properly wipe yer drive, remove it from yer case and give it a mean smack with a ball-peen hammer. This should pop the top off. Now take a clean piece of cheese cloth (a felt hat will do in a pinch), dip it in rubbing alcohol, and swab the drive platter real careful, like yer applyin' lacquer on a dainty lil' birdhouse. Now put the top back on the drive, put the drive back in your PC, and yer good to go.

Naw, don't thank me—my bill's in the mail.

So just how do you remove a freelancin' potato tot from the inside of yer computer case? Well, it all depends on whether it's a generic tot, or a regulation, Ore-Ida brand Tater Tot. If yer dealin' with them riff-raff generic tots, leave it be. I said leave it be! It ain't hurtin' no one in there, and you wouldn't want it back anyhoo. But if you dropped a pedigreed Ore-Ida brand Tater Tot into the deep recesses of yer case, ya'll have a few extraction options.



First, you can shake the case up and down like yer stranglin' the town drunk with yer bare hands. Or you can bash the case up against a river rock, like yer tryin' to stun a sassy brook trout. Or you can grab a bottle of sarsaparilla, shake it up good, and then flush out that prized Ore-Ida like you were flushin' away pig guts at the old slaughterhouse.

Now these are all good strategies, but if you have the time, you might want to learn yerself a trick pioneered by Gilbert Wallace, the notary public in Calhoun County. Old Gil lost himself a particularly prized Ju Ju Bee in a full-tower case, so he trained Mr. Fussbudget, his blue-ribbon ferret, to shimmy into the case through one of the fan ducts, establish control of the Ju Ju Bee, and then return it to safety, in one of the slickest search-and-rescue missions you'll ever see this side of *Rambo: First Blood Part II.*

Now if Mr. Fussbudget hadn't eaten the Ju Ju Bee upon his most triumphant return, Gil would have definitely had himself a story to tell the children. Losing food in computers cases is a big problem 'round these parts, people, so don't get caught with yer pants down: Learn yer ferrets proper militia discipline, and learn 'em good!

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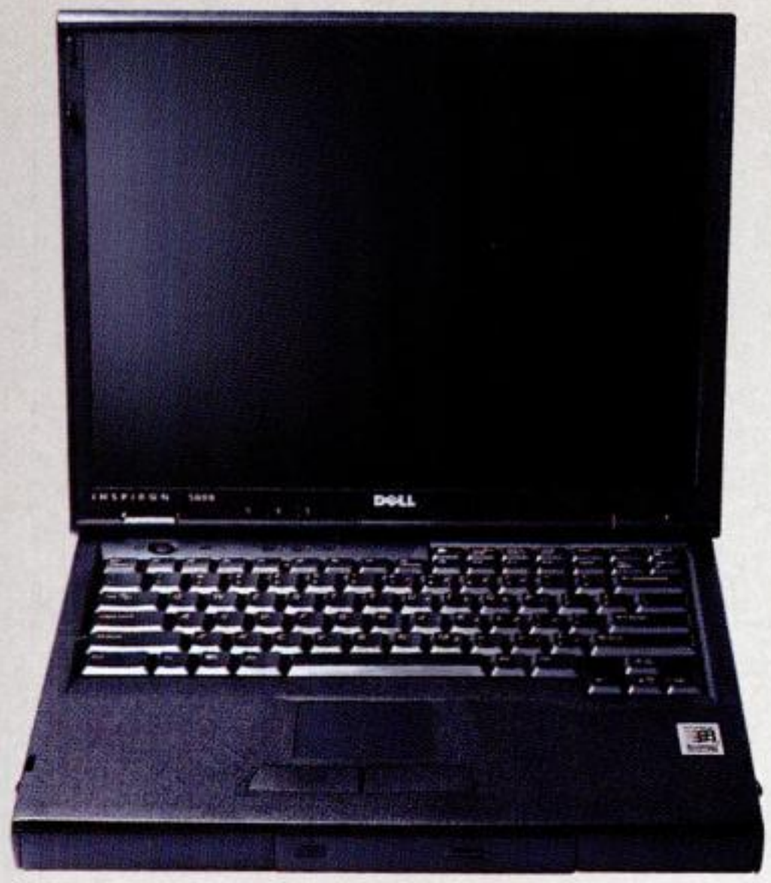

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required. [12]Online backup services provided by third-party agreement with the customer. Limited to 20MB of storage; additional space available at additional charge. Dell is not responsible for lost data. [16]Software, packaging and documentation differ from retail versions. [18]For select Hewlett Packard printers. [21]Limited time offer. Includes one (1) DVD title (max. $20.00 value, including tax and shipping) with purchase of a new Dell system with a DVD-ROM drive. See details at www.dell.com/dellzone. Offer must be redeemed over the Internet within 60 days from invoice. Limit one per customer. [22]Includes one (1) upgrade and online technical support from MusicMatch. [28]Based on Intel AGP 4X Graphics Test and Platform Bandwidth Test. [29]Limited time offer. Offer available only to U.S. customers. Limit one per customer. Internet access required to register for the offer. [32]The processor may be reduced to a lower operating speed when operating on battery power. Intel, the Intel Inside logo, and Pentium are registered trademarks; Intel SpeedStep and Celeron are trademarks of Intel Corporation. MS, Microsoft, IntelliMouse, and Windows are registered trademarks of Microsoft Corporation. HP and DeskJet are registered trademarks and OpenView is a trademark of Hewlett Packard Corporation. Trinitron is a registered trademark of Sony Corporation. ©2000 Dell Computer Corporation. All rights reserved.

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[10]Includes 150 hrs./month, plus $1.50/hr. (or fraction) over 150 hours. #800/888/877 access charged $4.95/hr. extra. Excludes taxes and telephone charges. Additional $1.00/hr. surcharge in HI and AK. [17]Monthly payments based on 13.99% APR. APR FOR QUALIFIED CUSTOMERS VARIES BY CREDITWORTHINESS OF CUSTOMER AS DETERMINED BY DELL FINANCIAL SERVICES L.P. Taxes & shipping charges extra, and vary; they are due with 1st payment unless included in the amount financed. Purchase Plan from Dell Financial Services L.P. to U.S. state residents (including D.C.) with approved credit, excluding AR and MN residents. Availability may be limited or offer may vary in other states.

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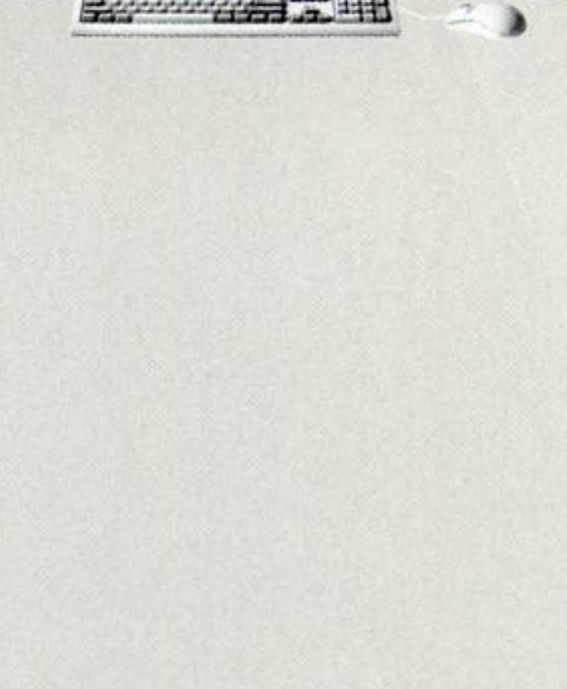
HOW MUCH SPEED DOES MY PC NEED? MORE THAN MY FRIEND BOB'S.



Congratulations. You just left Bob and his computer back there about half a mile, standing in a cloud of your dust. Meanwhile you're cruising at Mach II thanks to the new motherboard. Combined with RDRAM, it offers up to a 116% increased memory performance gain over earlier systems.[28] The result — *WHOA!* Start it up and you'll find that everything is faster, smoother, more realistic and more intense. Technology at warp speed. It's one more benefit of the Dell4me™ total ownership experience. A complete resource for products and services that make it easy for you to get the most out of technology.

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- *NEW* 32MB NVIDIA geFORCE 4X AGP Graphics Card
- *NEW* 12X Max DVD-ROM Drive
- SB Live! Value Digital with MusicMatch® Jukebox Enhanced[22]
- Harman Kardon HK-595 Surround Sound Speakers with Subwoofer
- V.90 56K Capable® PCI Telephony Modem for Windows®
- *NEW* Microsoft® Works Suite 2000 with Money 2000 Basic
- Microsoft® Windows® 98, Second Edition ■ QuietKey™ Keyboard
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[10]Includes 150 hrs./month, plus $1.50/hr. (or fraction) over 150 hours. #800/888/877 access charged $4.95/hr. extra. Excludes taxes and telephone charges. Additional $1.00/hr. surcharge in HI and AK. [17]Monthly payments based on 13.99% APR. APR FOR QUALIFIED CUSTOMERS VARIES BY CREDITWORTHINESS OF CUSTOMER AS DETERMINED BY DELL FINANCIAL SERVICES L.P. Taxes & shipping charges extra, and vary; they are due with 1st payment unless included in the amount financed. Purchase Plan from Dell Financial Services L.P. to U.S. state residents (including D.C.) with approved credit, excluding AR and MN residents. Availability may be limited or offer may vary in other states.

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